Metals Review

Published by the American

LOS ANGELES PUBLIC LIBRARY
ATT: HELEN E. LAUGHLIN
630 WEST FIFTH ST.
LOS ANGELES, CALIF.
L A

November 1959

Earle C. Smith
A.S.M. Honorary Member
(See Article, Page 4)

TOMORROW DEPENDS ON NUCLEAR POWER

Pictured above is David W. Lillie, a nuclear metallurgist and hence one of a group that's exceedingly important, alarmingly too few.

Dave is a recognized authority on nuclear research and physical metallurgy of reactor metals. Right now he is with the General Electric Research Laboratory doing specialized long range research in nuclear materials problems. But what makes him important to you, personally, is his authorship of the Metals Engineering Institute's home study course, *Metals for Nuclear Power*.

Now you can learn, from David Lillie, many aspects of currently available information about the role of special metals in the realm of nuclear power.

And keep this in mind as you read on—*Metals for Nuclear Power* contains *authoritative* material, *current* material, *valuable* material. It was written by an expert. It is offered by the Metals Engineering Institute—a division of the American Society for Metals, a respected and honored Society with *forty years* of educational success in the metal industry.

But why should the course interest you? Here's why. What is of more interest to the metal industry than the development of metals for nuclear power?—where is the potential greater?—and will not the demand for nuclear metallurgists grow and grow as industry becomes more and more nuclear minded? That's why you should take the course. Be ready. Be current. Be able. Be available.

If you have a B. Sc. degree or equivalent practical experience, your enrollment will be accepted; you will learn nuclear metallurgy via the Metals Engineering Institute.

"METALS FOR NUCLEAR POWER"

THE GREATEST, MOST AUTHORITATIVE AND UP-TO-DATE COLLECTION OF NUCLEAR METALS INFORMATION EVER ASSEMBLED IN COURSE FORM FOR INDIVIDUAL HOME STUDY OR IN-PLANT GROUP TRAINING.

Lesson 1—Energy Sources Today and Tomorrow.
Lesson 2—Atomic Structure, Particles, and Rays.
Lesson 3—Nuclear Fission and the Chain Reaction.
Lesson 4—Reactors: Principles, Components, and Types.
Lesson 5—Sources and Processing of Uranium Ores.
Lesson 6—Metallurgy of Uranium.
Lesson 7—Plutonium and Thorium.
Lesson 8—Moderators, Reflectors, and Shields.
Lesson 9—Reactor Control.
Lesson 10—Structural Materials.
Lesson 11—Coolants.
Lesson 12—Radiation Damage.
Lesson 13—Fuel Processing and Waste Disposal.
Lesson 14—Radiation Detection and Handling Techniques.
Lesson 15—Materials Research Safety in a Nuclear World.

This is only a brief sampling of the comprehensive material covered in *Metals for Nuclear Power*. Each lesson is thorough and extensive. Collectively, the lessons comprise a reference book unobtainable elsewhere.

17 COURSES FOR HOME STUDY OR IN-PLANT TRAINING ARE NOW AVAILABLE FROM MEI

- ☐ Elements of Metallurgy
- ☐ Heat Treatment of Steel
- ☐ High Temperature Metals
- ☐ Titanium
- ☐ Metals for Nuclear Power
- ☐ Stainless Steels
- ☐ Electroplating
- ☐ Blast Furnace Operations
- ☐ Arc Welding
- ☐ Gray Iron Foundry
- ☐ Oxy-Acetylene Welding
- ☐ Steel Foundry Practice
- ☐ Steel Plant Processes
- ☐ Tool Steels
- ☐ Copper, Brass and Bronze
- ☐ Magnesium
- ☐ Primary & Secondary Recovery of Lead and Zinc

METALS ENGINEERING INSTITUTE
a division of
AMERICAN SOCIETY FOR METALS

For full information on Metals for Nuclear Power and other MEI courses, please mail this coupon—at no obligation.

METALS ENGINEERING INSTITUTE
Metals Park, Dept. R119
Novelty, Ohio

Name ....

Address ....

City .... Zone .... State ....

Company ....

☐ Check here if you would like a brochure on in-plant training procedures.

Metals Review

The News Digest Magazine

November, 1959
Vol. XXXII, No. 11

Betty A. Bryan, Editor
A. P. Ford, Sales Manager
G. H. Loughner, Production Manager

•

DISTRICT OFFICES

William J. Hilty
Rodney W. Cramer
Metals Park, Novelty, Ohio
JOrdan 4-2271

John B. Verrier, Jr.
Fred Stanley
342 Madison Ave., Room 1228
New York 17, N. Y.
OXford 7-2667

Victor D. Spatafora
53 West Jackson Blvd.
Chicago 4, Ill.
WAbash 2-7822

Donald J. Walter
20050 Livernois St.
Detroit 21, Mich.
UNiversity 4-3861

William F. Mills
(Whaley-Simpson Co.)
6608 Selma Ave.
Los Angeles 28, Calif.
HOllywood 3-7157

Gordon Simpson
(Whaley-Simpson Co.)
700 Montgomery St.
San Francisco 11, Calif.
SUtter 1-4583

•

Published monthly by the American Society for Metals, Metals Park, Novelty, Ohio: Walter Crafts, President; W. A. Pennington, Vice-President; R. J. Raudebaugh, Treasurer; W. E. Jominy, Secretary; Earl Parker, M. A. Scheil, C. H. Samans and A. R. Fairchild, Trustees; C. H. Lorig, Past President. Subscriptions, $6.00 per year ($7.50 foreign). Single copies $1.50. Entered as Second Class Matter, July 26, 1930 at the Post Office at Cleveland, Ohio, under the Act of March 3, 1879.

Claims for missing numbers will not be allowed if received more than 60 days from date of issue. No claims allowed from subscribers from overseas, or because of failure to notify the circulation department of a change of address or because copy is "missing from files".

CONTENTS

Important Lectures

Departments

Republic's Earle Smith Made Honorary Member A. S. M.

Honorary membership in the American Society for Metals is the highest honor conferred by the Society in recognition of one man's contribution to metallurgy and the profession. Earle Clement Smith, chief metallurgist and director of research for Republic Steel Corp., is deserving of this honor—conferred only 24 times in the 41-year history of the Society. He has been pre-eminent in the application of science to steelmaking and a zealous worker for advancement of the metallurgical profession.

Since the beginning of his career in 1915, Earle Smith has applied his tremendous energy to diagnosis and solution of diversified metallurgical problems. Fortunate for steel producers and users alike he has always shared his intimate knowledge of steelmaking and materials for the benefit of others. From his store of information he freely gives something to everyone who comes to him for enlightment. This noble attribute in particular was recognized last year when he was named honorable foreign member of Verein Deutscher Eisenhuttenleute—and honor rarely given outside Germany. This honor came out of gratitude of the Verein for his exchange of fruitful know-how and for the practical assistance he has given many of its members.

While a great part of his career has been devoted to practical aspects of steelmaking, Earle Smith always found time to study the theoretical side of the process. He applied principles of microscopic mineralogy to classical studies on the constituents of basic openhearth slags and their influence on the steel bath—giving rise to the precept "if your slag is right your steel is right". His enthusiasm and keen perception have spurred such important developments as the use of top pressure in blast furnace operations and the direct reduction of iron ores.

He has acted as co-ordinator of the varied research activities which Republic Steel Corp. has, for years, carried out in the practical workshop of the company's plants, manufacturing divisions and mines. Recently, with the completion of Republic's new Research Center he was assigned the additional duties of director of research, which formalizes his past relationship with the company's research programs and delegates to him direct responsibility over basic and applied research. This responsibility comes to Earle Smith as recognition of his unique ability to translate the results of research investigations into practical values.

His knowledge was put to the service of the nation during World War II when his advice was sought on countless problems connected with ordnance steels. He was directly responsible for rolling ingots into blooms for gun forging plants. He has served the country on numerous metallurgical committees and missions.

The American Society for Metals honored Earle Smith with its Gold Medal in 1946 and as Campbell lecturer in 1950. His contributions to the metals industry and to metallurgical education have been recognized on numerous other occasions. For several years he was chairman of the Advisory Council for Science and Engineering of the University of Notre Dame. Both Ohio State University—his alma mater, and Case Institute of Technology, have awarded him the Doctor of Science degree.

Earle Smith—metallurgist extraordinary—has shown remarkable prowess in putting scientific findings to practical use for steel producers and consumers. His work and his willingness to help others have benefited greatly the whole metals industry and the metallurgical profession.

Discusses Isothermal Transformation

R. A. Grange, U. S. Steel Corp., Spoke on "Isothermal Transformation of Austenite" at Indianapolis. Shown are, from left: Dean Hanink, secretary; G. Sommer, vice-chairman; Mr. Grange; and Charles Patton, chairman

Speaker: R. A. Grange
U. S. Steel Corp.

R. A. Grange, Research Center, U. S. Steel Corp., spoke on "Isothermal Transformation of Austenite" at a meeting in **Indianapolis.**

Scientific study of the heat treatment of steel is of recent origin. In 1930, Davenport and Bain published their work on the effect of time and temperature on austenite transformation. Since then they and other investigators have developed the TTT curves, or S curves, which serve as maps to chart effect of heat treatment on the structure and properties of various plain carbon and alloy steels. Two early methods of studying the transformation of austenite were by thermal analysis and length changes.

The most informative method of studying these transformations is the metallographic examination of specimens that have been held at constant temperatures for appropriate periods.

Mr. Grange showed slides of S or TTT curves for plain carbon and alloy steels and cooling curves with microstructures. He discussed briefly the effects of composition on the transformation curves namely:

1. Differences in percentage of carbon makes a big difference in appearance of diagrams—Bainite is slower to form with higher carbon.
2. Non-carbide formers slow down transformation at all temperatures.
3. Carbide formers pull curve back to the right in the pearlite region.

The transformation products giving the best physical properties are lower bainite or very fine pearlite. The intermediate products are not good.—**Reported by Dorothy Holbrook for Indianapolis.**

MAKE A DATE
FOR DALLAS

Second Southwestern Metal Exposition and Congress Will be Held in

Dallas . . .
May 9-13, 1960

Outlines Various Methods of Joining

"Joining of Metals" Was the Topic Discussed by Arvid C. K. Nihlen, Griscom-Russell Co., At a Meeting Held by the Canton-Massillon Chapter. Shown are, from left: W. W. Scheel, then chairman; Mr. Nihlen; and G. P. Michalos, then vice-chairman. (Photograph taken by W. R. Flickinger)

Speaker: Arvid Nihlen
Griscom-Russell Co.

A talk entitled "Joining Of Metal" was presented before members of the **Canton-Massillon Chapter** by Arvid C. K. Nihlen, Griscom-Russell Co.

The speaker covered all phases of joining, with special emphasis on welding methods. The popularity of welding has steadily increased throughout the years to the point where 35 different methods of welding are in existence today. Of special interest in his talk was the discussion on heliarc and atomic hydrogen arc welding methods.

In the heliarc welding process an inert gas, such as helium, is used to shield the arc, thereby eliminating the necessity of a flux. This process has the advantage of giving a weld free from flux inclusions.

The principle of the atomic hydrogen welding process is based on the following reaction: $H_2 \rightarrow H \rightarrow H_2 +$ heat. The molecules of the hydrogen atmosphere surrounding the arc are broken down into atoms by the arc with the absorption of energy. These dissociated atoms, when placed into contact with the metal, recombine, giving up the absorbed heat to the metal. Freedom from oxidation and the high temperatures attained are the big advantages apparent in this process.

Other welding processes discussed were forge welding, resistance welding and dip transfer welding.

In the discussion of brazing methods, the speaker emphasized the importance of temperature control. The various methods of brazing, including batch, pit, elevator, manual pressure and bell types, were discussed. It was brought out that silicon, titanium and aluminum alloys are quite difficult to braze.

At the present time soldering, as a method of joining, is used mostly by the electronics industry. Of interest in connection with this method is the fact that soldered joints have the best strength in shear rather than tension.

The various types of metal fasteners, such as rivets, bolts and screws, were discussed and the relatively new field of plastic binders, such as the thermosetting resins, was also reviewed by the speaker.

Mr. Nihlen concluded his talk with a summary of where we stand now in the joining field and what we may expect in the future, and answered several questions from the audience. —**Reported by George Matthews for Canton-Massillon Chapter.**

Worcester Executive Committeemen Hold Meeting

Members of the 1959-60 Executive Committee of the Worcester Chapter Who Attended a Meeting to Discuss This Year's Program Included, From Left: Kenneth H. Lever, Thompson Wire Co.; Paul J. Lisk, Greenman Steel Treating Co., Assistant Secretary; Gordon T. Rideout, Norton Co.; D. J. Coleman, Economic Machinery Co.; Leonard L. Krasnow, Lodding Engineering Corp., Past Chairman; L. T. Maher, Draper Corp.; H. J. Holmes, Heald Machine Co., Vice-Chairman; A. L. Stowe, Vanadium Alloys Steel Co., Chairman; R. J. Uppvall, Worcester Stamped Metal Co.; R. N. S. Merritt, Jr., Olson Manufacturing Co., Secretary-Treasurer; G. L. Durfee, Wyman-Gordon Co.; and Gregory J. Shandrick, Lundquist Tool & Manufacturing Co.

"Mechanisms of Hardening" Were Covered in the Annual Seminar Sponsored by the Chicago-Western Chapter. Shown are, from left, top: M. D. Kilbridge, University of Chicago; R. W. Hanzel, chairman (1958-59); M. E. Fine, Northwestern University; and R. W. Guard, General Electric Research Laboratories. At bottom, from left: F. V. Lenel, Rensselaer Polytechnic Institute; P. A. Flinn, Westinghouse Electric Corp.; C. S. Barrett, Chicago University; and D. J. Mack, University of Wisconsin, the moderator

Chicago-Western Sponsors Seminar on Mechanisms of Hardening

The **Chicago-Western Chapter's** one-day seminar on the "Mechanism of Hardening", featuring talks by a battery of experts, was attended by about 190 professional men and students. D. J. Mack, University of Wisconsin, acted as moderator.

Scientific Background

C. S. Barrett, Institute for the Study of Metals, Chicago University, talked on "Scientific Background of Metal Hardening". After describing classical dislocations (i.e., edge and screw dislocations) he pointed out that actual dislocations in metals can be resolved into the above types. Several methods have been developed to reveal dislocations, such as: (a) X-ray techniques based on the Berg-Barrett method; (b) etched slip lines; and (c) direct photography in transparent crystals. In the latter method impurities which are opaque relative to the crystal itself are diffused through the dislocation, thus revealing its outline. However, the method which is attracting the most attention is the direct observation of dislocations by electron microscopic examination of thin foils (10-100 A thick).

Polarized light examination of silicon single crystals with a single dislocation has revealed the presence of a stress field surrounding the dislocation itself. It is this stress field which is responsible for the interaction between dislocations which, in turn, causes hardening.

The most recent theories on how dislocation interactions and locking cause hardening in both hexagonal and body-centered cubic structures were reviewed and illustrated. Locking is promoted by grain and subgrain boundaries, by stacking faults, and, to a much lesser extent, by the atoms themselves which oppose dislocation motion. Prof. Barrett briefly reviewed the mechanisms of hardening in solution-precipitation systems and in ordered structures.

Precipitation Hardening

M. E. Fine, chairman, metallurgy department, Northwestern University, lectured on "Solution and Precipitation Hardening". His talk was concerned with solution and precipitation hardening mechanisms which are due to "segregations": (a) Guinier-Preston zones—age hardening and precipitation hardening; (b) segregations of solute atoms at dislocations—Cottrell atmospheres; (c) segregation of solute atoms at stacking fault regions—Suzuki locking; and, finally (d) hardening mechanisms which are due to vacancy clusters—quench hardening.

Guinier-Preston zones have been observed experimentally in many systems and play a major role in the hardening which occurs in commercial heat treatable aluminum alloys. They consist of segregation or clustering of solute atoms at certain regions of the crystalline lattice. In Al-Cu alloys the G-P zones have a platelike appearance—one or two atoms thick and 25-50 atoms in diameter. On the other hand, in the Al-Ag system they are spherical. Their kinetics of formation are not a function of grain size. Quenched-in vacancies are thought to be responsible for their rapid formation at room temperature. Strengthening results from the stress field due to the mismatching between different atomic sizes and also from the cutting of these zones by dislocations.

Suzuki hardening relies upon the interaction of solute atoms with dissociated dislocations in the close-packed planes of face-centered cubic and close-packed hexagonal structures. These dissociated, or half-dislocations, give rise to stacking faults, or disruptions in the atomic planes' periodicity. Within this stacking fault region the concentration of solute at-

oms differs from the average thus causing hardening. Alpha brass is thought to follow the Suzuki mechanism of hardening.

Hardening has been observed in gold quenched from temperatures near the melting point and aged at room temperature. This treatment results in strengths up to seven times stronger than if slowly cooled or tested immediately after quenching. It has been suggested that this hardening is due to formation of collapsed vacancy clusters.

Order Hardening

P. A. Flinn, section manager, metallurgy department, Westinghouse Electric Corp., started his talk on "Order Hardening" by reviewing the meaning of local and long-range ordering and explaining the characteristics of anti-phase domains.

Both short and long-range order strengthens alloys by hindering the motion of dislocations; however, the mechanism, magnitude and temperature dependence of the effects are quite different. Thus the effect of short-range order is due to the work required to disorder the slip plane as the dislocation moves on it; however, after the motion of the first dislocation along the slip plane, further slip occurs quite easily along this same plane, the net result being that in these structures deformation occurs mainly on a few planes. Furthermore this effect is relatively independent of temperature but very dependent on concentration.

On the other hand, the effect of long-range order is more complicated and it involves the interaction between anti-phase boundaries and dislocations. The stress required to cause slip varies inversely with the distance between anti-phase boundaries. Since more anti-phase boundaries are formed as slip occurs, the strain hardening rate is higher than for disordered alloys. The role of temperature is quite pronounced since as the temperature is raised an increase in yield strength is noted, followed by a drop due to rapid diffusion at progressively higher temperatures. Such an increase in yield strength is observed in ordered nickel-base alloys. The creep strength of these alloys is also improved by this hardening. Commercial alloys that take advantage of this phenomenon are currently being developed. Unfortunately, this strong matrix is associated with grain boundary fracture.

Dispersion Hardening-I

F. V. Lenel, Rensselaer Polytechnic Institute. preceded his talk on "Dispersion Hardening From a Phenomenological Viewpoint" by defining dispersion hardening as the hardening effect produced by a finely dispersed insoluble second phase in a metallic matrix. In contrast to precipitation hardened alloys, which are produced by solution treating and quenching an alloy in which the second phase goes into solution at an elevated temperature but precipitates upon quenching and holding at a lower temperature, the second phase in dispersion hardened systems has very little solubility in the matrix even at temperatures near the melting point.

The important characteristics of dispersion hardened alloys are retention of high strength near the melting point and moderate ductility over the entire temperature range.

These alloys may be prepared by two general methods—precipitation of an oxide phase formed by diffusion and internal oxidation of the solute which is less noble than the matrix, and by powder metallurgy. This latter method may be further subdivided into: (a) precipitation of an insoluble phase by "interference" hardening as precipitation of a zirconium-aluminum intermetallic compound in a magnesium phase, when magnesium, aluminum and zirconium powders are mixed and co-extruded, and (b) pressing and extruding finely dispersed mixtures of a metal powder and a second phase; S.A.P. (sintered aluminum powder) is the best known example of the latter.

The inherent disadvantage associated with internally oxidized alloys is the diffusion of O_2 into the metallic matrix, a process which is slow since it is controlled by a parabolic rate. Furthermore these alloys usually display coarse particles near the surface and, in some systems, appreciable spacing between particles; nevertheless, strength improvements at elevated temperatures are reported.

The remarkable elevated temperature properties of dispersion strengthened alloys do not seem to depend on coherency, but rather the major role is played by the distance between particles of the second phase.

In general these alloys do not recrystallize or exhibit grain growth after cold working and heating up to temperatures approaching the melting point provided the second phase spacing does not exceed certain values.

The remarkable elevated temperature strength and creep characteristics of these alloys have prompted numerous investigations to try to develop S.A.P. type alloys with other metals and alloys.

Dispersion Hardening-II

R. W. Guard, research associate, General Electric Co., Research Laboratory, introduced his lecture on "Dispersion Hardening From a Mechanistic Viewpoint" by defining two types of dispersions—the aggregate structure and the dispersed structure. In the first the dispersed particles and the matrix are separated (i.e., the particles are dispersed intergranularly) whereas in the second one, the dispersed phase is dispersed throughout the matrix (i.e., it is distributed intragranularly). The manner in which dislocations and the dispersed particles interact differs in the two types of structures. Thus, in the aggregate structure a dislocation coming up to a particle which is hard and cannot be cut through has no other alternative but to circumvent the obstacle. In this case the stress required to push the dislocation between the particles is inversely proportioned to the distance between them. In general, as more and more dislocations go through, the harder it becomes for successive ones to go through strain hardening. This theory was originally proposed by Orowan; however, several modifications have been made to take into account coherency between particles and matrix and dislocation loops left behind when dislocation segments pass between the particles.

The intragranularly distributed structure is much more difficult to analyze since dislocation movement is not only hindered by the dispersed particles but it is also stopped by the grain boundaries. Thus grain size plays an important role.

In general it can be stated that particles interfere with movement of dislocations or slip; the effectiveness of this interference is dependent on the mechanism by which dislocation motion can avoid the particles.

Many dispersion hardened systems are limited by their poor fracture characteristics (i.e., a ductile-to-brittle fracture transition occurs as the temperature is raised). In general such brittle fracture occurs at the interface between the matrix and the second phase. The main role of dispersed particles on fracture is related to their effect on crack propagation.

The question of how the dispersed structure prevents softening or recrystallization has not been analyzed quantitatively; however, Dr. Guard advanced the hypothesis that the largest matrix area is smaller than the critical nucleus size for recrystallization; furthermore the mean particle distance is smaller than the maximum boundary curvature possible with the available driving force for recrystallization. Actually, gross recrystallization is prevented by the lack of boundary migration on a large scale even though some recovery or recrystallization in situ may occur.

Consideration of the theories suggests that development of dispersion hardened alloys should be done with the following thoughts in mind: (1) finer matrix particles (or smaller matrix mean free path) will give higher strength, (2) noncoherent, nondeformable and insoluble (to the melting point of the base metal) particles will have the largest effect, all other factors being equal, and (3) both inter and intragranular particles are required for the best results.—**Reported by D. J. Garibotti for Chicago-Western.**

Reviews Vacuum Melting in Phoenix

William F. Davenport, Universal-Cyclops Steel Corp., Spoke on "Vacuum Melting High-Strength Steels" at a Meeting in Phoenix. Shown are, from left: Merle C. Nutt, treasurer; Charles Mulkin, secretary; Ralph Russi, chairman; Mr. Davenport; and Warren Travis, vice-chairman of the Chapter

Speaker: W. F. Davenport
Universal-Cyclops Steel Corp.

Phoenix Chapter's first meeting this season featured a talk by William F. Davenport, West Coast metallurgical engineer, Universal-Cyclops Steel Corp., on "Vacuum Melting High Strength Steels".

Over the past few years three new vacuum processes have come into prominence — vacuum degassing, induction vacuum melting and consumable electrode arc melting. All three of these techniques have attained commercial success and are replacing air melting for a good many applications, and these techniques are beginning to compete with each other for popularity.

Mr. Davenport showed some fine color sound movies of these processes in actual operation, pointing out the advantages and shortcomings of each. He stated that the consumable electrode arc vacuum melting process came into its own about 10 years ago for melting refractory and reactive metals that cannot be contained in regular crucibles in the molten state. There are about 27 of these furnaces in the U. S., put in for titanium, zirconium, molybdenum and other refractory and reactive metals. A wide variety of vacuums is now used in this process, with some installations melting below 1 micron and others in the range of 50 to 300 microns, these measurements being only relative since the pressure must be taken at some distance from the arc which has a temperature as high as 8500° F.

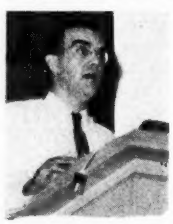
So far the largest use of the consumable electrode arc steel remelting process has been to produce billet material for jet engine turbine disks in A-286 alloy. Ingots up to 26 in. diameter and 16,000 lb. have been melted. In fact, Universal-Cyclops now has space allotted for a furnace capable of making ingots 40 in. in diameter and weighing 29,000 lb. There is theoretically no size limit to this technique.

After the meeting Mr. Davenport was presented a year's subscription to the colorful magazine *Arizona Highways* in appreciation of his talk and visit to the Chapter.

Forming Methods Subject Of Educational Lecture

Speaker: R. F. Adams
General Electric Co.

Revolutionary new "Forming Methods" were discussed by Richard F. Adams of the Metals Processing Laboratory, General Electric Co., at the first lecture of the **Chicago-Western Chapter's** 1959 educational series. Space age demands for tolerances of 10 millionths of an inch on parts whose profiles are engineeringly nightmarish have virtually revolutionized the forming industry. Many new machines based on the novel combination of old and new forming principles have made their appearance.



Hot and cold extrusion is steadily gaining a greater industrial acceptance since this technique enables one to wipe out the segregated, coarse-grained structure of the "as cast" blanks at a significant material savings. Mr. Adams pointed out that material removal by machining methods represents a sizable expense in both material loss and the labor cost in generating chips, a luxury you may no longer be able to afford.

Roll forming is a mechanized version of the ancient spinning process. "Exotic" alloys used in rockets and missiles which are most difficult or impossible to machine are everyday accomplishments with this process.

Even the art of the blacksmith has been mechanized. Automatically controlled hot and cold forging machines have been developed, producing complex parts at less cost than machining from bar stock.

Explosive forming, still thought of as a curiosity, has been reduced to production reality. The success of high energy rate forming in accomplishing metal shaping is attributed to the high pressures and velocities at which metal movement takes place.

Many of the advantages of the extrusion process can be fully utilized as practical production processes if properly applied. New developments in metals and equipment design offer the opportunity for great studies for cost reduction, improved quality and applications to many design possibilities not economically attainable by other production methods.

During World War II, Prof. P. W. Bridgeman of Harvard conducted tests on the plastic flow and fracture of metals under extremely high pressure in which it was observed that ordinary steels increased enormously in ductility when exposed to hydrostatic pressure in the 300.000 to 450,000 psi. range. Since the war Russia has exploited this phenomenon for production purposes.

The stretch forming process and many of its applications was described and demonstrated with the aid of a motion picture.

Mr. Adams described the operation of a number of available commercial machines. He illustrated typical products of these machines by means of a series of slides. He also discussed the technical and economic limitations of each process.—**Reported by Arthur Kramer for the Chicago-Western Chapter.**

Cites Curricula Changes in Keeping Pace With Industry

Speaker: H. R. Hanley
Missouri School of Mines and Metallurgy

Herbert R. Hanley, professor emeritus of metallurgical engineering, Missouri School of Mines and Metallurgy, and a graduate of the School, presented a talk on the "Metallurgical Aspects of Missouri's Curricula and Industry" at a meeting held there.

After presenting a picture of the progress made by the school with the advancements in the field, Dr. Hanley pointed out the many ways in which metallurgy is linked with other industries, and discussed developments within the metals industry, how metals were first discovered by the ancients and how metallurgy developed with the discovery of fire. He also spoke on the change of metallurgy from an art into a science and its influence on modern civilization.—**Reported by Mario Padilla for Missouri School of Mines and Metallurgy Chapter.**

Talk on Fine-Grained Castings at Meeting In Eastern New York

Speakers: A. J. Kiesler and J. L. Walker
General Electric Co.

"Fine-Grained Castings" was the subject covered at a joint meeting of the **Eastern New York Chapter,** A.S.M. and the American Foundry Society by A. J. Kiesler and J. L. Walker, General Electric Research Laboratory.

The speakers discussed the principles and practice of producing fine grains in cast structures. Much of the nonuniformity and undesirable properties of castings results from the inhomogeneous structure formed from a relatively homogeneous liquid. While in some cases the grain size can be reduced by heat treatment, a fine-grained casting is more desirable.

In attempting to control the as-cast grain size, the metallurgist has at his disposal three variables: composition, temperature and pressure. To minimize the columnar zone in a casting the nucleation of new grains must be increased. Nucleation agents can be added to the melt which provide nucleation sites for new grains, thus taking advantage of the constitutional undercooling present in alloy systems. The materials used for nucleation agents should be similar chemically and structurally to the cast material. In controlling the temperature, the metallurgist must be careful not to superheat and dissolve the nucleating catalysts. A high pouring temperature increases the temperature gradient in the casting and increases the tendency toward coarser grains. The speakers discussed the effect of vibrations on the resulting grain size. They attributed the vibration effect to a localized increase in pressure and hence a localized increase in nucleation.

Ferritic steel castings can be heat treated to a finer grain size whereas this method is unavailable for steels which undergo no transformations, such as the austenitic stainless steels. The common stainless steels have a small melting range which further tends to produce coarse grains. Elements can be added to extend the melting range and nucleating agents can also be added. Some materials, such as X-40, which have many components have a large melting range and inherent nucleating agents. The grain size then can be controlled by the pouring temperature. It appears to be questionable whether in all cases a fine grain size is wanted. For instance, the high-temperature mechanical properties of some materials are enhanced by coarser grains.—**Reported by Louis Ianniello for Eastern New York.**

Washington Chapter's 1959-60 Officers

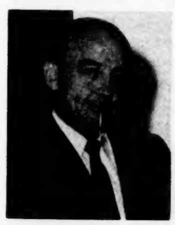
1959-60 Officers of the Washington Chapter Include, From Left: Earl T. Hayes, Executive Committee; Irving J. Fineberg, Executive Committee; Joseph L. Gillman, Executive Committee; Glenn W. Geil, Secretary; William L. Holshouser, Chapter Chairman; and Richard Raring, Vice-Chairman

Modern Casting Methods Title of Second Lecture In Educational Series

Speaker: R. W. Heine
University of Wisconsin

"Modern Casting Methods" were reviewed by R. W. Heine, professor, University of Wisconsin, at **Chicago-Western Chapter's** second lecture of the 1959 educational series.

Investment casting was discussed first. Due to the development of this technique, one can now produce castings with faithful reproduction of dimensions. Investment casting requires an expendable pattern, usually formed in an injection mold of wax or plastic. The pattern with its gating system is then dipped into a slurry of ceramic material and dried. The thin hardened shell can either be alternately dipped and dried to build up the shell or it can be inserted into a steel container filled with a a ceramic aggregate, vibrated to assure good contact between the thin shell and the aggregate and hardened. The former variation is possible only with small sections. After the mold is thoroughly dry, the low melting point pattern material is melted or dissolved out. A preheat to 1500 to 1800° F. is necessary to drive off the mold gases before pouring.



The Shaw process uses the conventional mold pattern. A slurry, essentially of ethyl silicate, is poured around the pattern. After setting, the rubbery mold is stripped from the pattern. The elastic nature of the mold material allows for some back draft. The mold is then burned, which sets the mold and crazes the surface, permitting the escape of gases when the mold is filled.

Reactive metals cannot be cast in molds made of conventional materials. Success has been achieved through the use of graphite molds. In some cases molds machined out of solid graphite are used; in other cases success has been achieved using a granular graphite molding aggregate as a substitute for molding sand.

The shell process pours a dry aggregate of sand and thermosetting resin onto a highly polished metal pattern. The pattern is heated and the aggregate set. The mold can be immediately stripped off and used.

The Antioch process utilizes a silica sand-gypsum slurry which is poured over the pattern. Chills can be inserted while the slurry is liquid and become an integral part of the mold. The mold is hardened under steam and pressure. This process produces light metal castings of high metallurgical quality.

A very rapid molding process blows an aggregate of silica sand, sodium silicate and sugar onto the pattern. Carbon dioxide is then forced into the aggregate and hardens the mold. The entire process, which is referred to as the CO_2 process, takes 15 seconds.

Prof. Heine pointed out, in conclusion, that the selection of the proper casting technique is a highly individualized and complex problem. A full knowledge of the advantages and disadvantages of each technique is necessary in order to make intelligent and profitable casting decisions. —**Reported by Arthur Kramer for the Chicago-Western Chapter.**

Apologies

Our apologies to the Philadelphia Chapter for crediting the Pittsburgh Chapter with originating the William Hunt Eisenman Medal and Bill Eisenman Night (in the story on C. H. Lorig, p. 4, August *Metals Review*).

The Philadelphia Chapter, originators of Sauveur Night, now held by several other chapters, also was the first to initiate this yearly memorial to Mr. Eisenman. Dr. Lorig received the second of these awards; the first was presented to Mrs. Eisenman.

Describes the Art of Spark Testing

Edsel E. Bishop, Wyckoff Steel Co., Presented a Talk on the "Art of Spark Testing" at a Meeting of Northwestern Pennsylvania Chapter. In the picture are, from left: Jack Biltz, technical chairman; Mr. Bishop; Clifford Lindquist, vice-chairman; and Ivan Marsteller, chapter chairman

Speaker: Edsel E. Bishop
Wyckoff Steel Co.

Edsel E. Bishop, metallurgical engineer, Wyckoff Steel Co., spoke at a meeting of the **Northwestern Pennsylvania Chapter** on "The Art of Spark Testing".

Mr. Bishop pointed out that spark testing is an ancient art which had been neglected until recently due to the complexity of alloys. Today several steel companies and large scrap dealers employ full-time spark testers to segregate steels.

He stressed that spark testing does not replace chemistry, but supplements it. It is possible to sort up to 600 pieces per hr. Equipment needed is a high-speed portable grinder with a speed of 6000 to 9000 surface ft per min. The wheel type varies with the type of steel being tested. Usually a medium grit is desired to make sure the wheel does not load up since the spark temperature is around 4000° F. Green tinted glasses are recommended to eliminate glare and give necessary contrasts between various elements in the spark stream.

One of the most important factors is to apply a constant pressure on the grinder to give a spark path 24 to 30 in. long. The spark test not only distinguishes between the various types of carbon, alloy and toolsteels, but tells whether a steel is rimmed, capped, killed or semikilled, the percent of alloy present, hardness, and to some extent, the grain size. It is also used to designate between some nonferrous metals. It is possible to train a spark-tester in approximately six weeks.—**Reported by Jack Biltz for Northwestern Pennsylvania Chapter.**

Heat Treatment of Toolsteels Is Topic

Speaker: J. C. Hamaker, Jr.
Vanadium Alloys Steel Co.

"The Heat Treatment of Toolsteels" was the subject of a talk given before the **Southern Tier Chapter** by J. C. Hamaker, Jr., director of research and metallurgy for Vanadium Alloys Steel Co.

Dr. Hamaker reviewed the various grades of toolsteels recognized under the current classification system, including water hardening, oil hardening, air hardening, high-carbon, high-chromium, hot work, high-speed and special purpose grades. Distinction between the various grades can also be made on the basis of characteristics such as wear resistance, hot hardness, toughness, hardenability, distortion and machinability.

General toolsteel heat treating cycles were outlined, and the effects of pre-heat, high heat, quench and temper stages upon properties and microstructures were explained. Photomicrographs were presented which illustrated microstructures produced by various heat treating steps.

Preheating has the advantages of reducing distortion and danger of cracking during heating and shortening the necessary time at the hardening temperature.

Each steel has an optimum hardening temperature range which should be strictly adhered to. Hardening temperatures below this range result in insufficient dissolution of carbides and hardenability is adversely effected. If hardening temperatures are too high, excessive carbide dissolution occurs and high percentages of retained austenite result. High hardening temperatures also have a grain coarsening effect and an accompanying adverse effect upon mechanical properties.

Toolsteels can be segregated into four categories describing response to tempering. Low-alloy steels continue to soften as tempering temperatures are raised. Air hardening steels show higher resistance to softening, but little or no secondary hardening. High-speed steels exhibit significant secondary hardening. Hot work steels have a flat hardness versus temperature curve, with secondary hardening.

Dr. Hamaker explained the mechanism of secondary hardening on the basis of two phenomena; the transformation of retained austenite and the precipitation of carbides. Some of the variables affecting the retention, transformation and stabilization of austenite were noted.

Carburizing, nitriding, sulphidizing, oxidation, chromium plating and super-finishing were outlined as surface treatments designed to increase tool life. Some examples of applications were presented, including free machining grades and the super wear-resisting high-carbon, high-vanadium toolsteels. High-vanadium high-speed steels are being used to an increasing extent in punch and die work, as well as the machining of superalloys and ultra-high-strength steels where their edge strength permits positive rake angles for improved cuttings.

Experience gained in the toolsteel industry has been a major factor in the development of "super strength" steels now used in aircraft and missile applications. The superiority of these steels over other materials, such as titanium, was illustrated.—**Reported by Frank Wagner, Jr., for Southern Tier.**

Gives Report on Russian Metallurgy at Syracuse

Speaker: A. M. Aksoy
Crucible Steel Co.

A. M. Aksoy, manager of the applied research laboratory at the Sanderson Holcomb Works, Crucible Steel Co., spoke on "Russian Metallurgy" at **Syracuse.**

Russia is placing considerable emphasis on its steel production. Its furnaces operate efficiently and at high capacity, primarily because of limiting the grades of steel being made and the amount of material handling equipment available.

Considerable work is being done in vacuum melting and Russia is commercially producing material by vacuum induction melting, vacuum arc remelting and vacuum degassing. It is further advanced in the latter process than we are. The Russian laboratories are also doing work in vacuum desulphurization, vacuum rolling and ultrasonic furnaces.

Dr. Aksoy touched briefly on the Russian educational system and on the large number of research facilities and equipment available to its technical people. — **Reported by G. Trojanowski for Syracuse.**

Schedule Two-Day Meeting

"Materials—Key to Space Flight" will be the theme of a two-day national meeting to be conducted in Cincinnati, Apr. 27 and 28, 1960, by the Cincinnati, Dayton and Columbus Chapters A.S.M. The purpose of the meeting will be to present in an unclassified manner a broad review of the unique demands made on materials by space flight systems, discuss progress made to date in satisfying these demands and point out the unsolved problems requiring intensive future efforts. The program has been carefully planned to cover the critical materials problems associated with launching, space flight and atmospheric re-entry of space flight vehicle systems. Speakers will be top technical experts from government and industrial organizations working in the field of space flight technology.

Meet Your Chapter Chairman

ROCKY MOUNTAIN

RICHARD F. SCHAFFER, a native of Denver, received his technical education at the Colorado School of Mines from which he graduated with a degree of metallurgical engineer in 1940. Immediately after graduation he took a position with Gardner-Denver Co. as assistant metallurgist and about a year ago was made chief metallurgist.

Within the Rocky Mountain Chapter he has served as publicity chairman, on the executive committee, and, on a national basis, is now serving on the Handbook Committee for the section on Cutting Tools. He is a member of other technical societies, and though not having held offices in these, his fellow members find Dick always a willing and productive worker. He manages to find time from his busy professional duties to indulge in some hunting and fishing. Dick is married and has three childern.

INDIANAPOLIS

CHARLES C. PATTON, an A.S.M. member since 1926, is a senior staff engineer, metallurgy, at Western Electric Co. His 33 years of service with this company have been spent primarily in the area of special developmental coatings and plating processes, all of which have been concerned with the electrical and electronics industry. He was one of the early experimenters in the field of vacuum melting to improve the purity of special alloys. Experience prior to joining Western Electric included a period at University of Chicago in the field of inorganic chemistry. His B.S. degree is from Lewis Institute of Chicago, now Illinois Institute of Technology.

Charlie Patton has offered his personal time in many instances to further the aims of the Indianapolis Chapter and has served as secretary and vice-chairman, and just recently as a member of the Handbook Committee on Materials for Plastic Dies.

Among his hobbies in the sporting area is a yen for deep sea fishing but his prime interest seems to lie in the hydridizing experiments on roses. His recognized authority in this field is attested by a current position he holds in the American Rose Society as rose judge.

CANTON-MASSILLON

GEORGE P. MICHALOS is a native of Canton and a graduate of Ohio State University. Following graduation he joined the metallurgical department of Timken Roller Bearing Co. A promotion made him general foreman of finish tube inspection and he is now superintendent of inspection, Steel & Tubes Division.

Mr. Michalos entered the Navy as an ensign during World War II and became commanding officer on a minesweeper, serving three years in the Pacific. He was recalled during the Korean conflict and served two years in the metallurgical research and development division of the Bureau of Ships in Washington. His favorite hobby is taking pictures of his two sons, Peter, 8, and Philip, 4 years old. Chief recreation is golf.

UTAH

J. M. "TEX" CARRERA, recently appointed works metallurgist at Columbia-Geneva Steel's Geneva Works, is a graduate of the Texas Western Branch of the University of Texas. He later completed special studies at the Universities of California and Utah. His nearly 20 years of service with U. S. Steel began in 1940 when he started as an inspector helper at the Pittsburg Works in California. A year later he was appointed sheet mill metallurgist, beginning a string of promotions which eventually brought him to his present position.

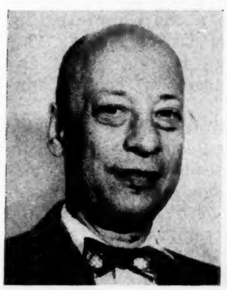
Mr. Carrera and his wife, Laura, are active in community work. They have a daughter, Lee, and a son, Calvin. Calvin is following a scientific career and recently won two awards in zoology and electronics at the regional Scientific Fair.

OTTAWA VALLEY

JOHN O. EDWARDS, who was born in Bury, England, received his B.Sc. degree, with first-class honors, and his M.Sc. degree, at Manchester University, where he also captained the swimming and water polo teams. Previously associated with British Aluminium Co., Ltd., at Warrington, Fort William and Latchford, he is now head of the nonferrous metals section, Mines Branch, Department of Mines and Technical Surveys, Ottawa.

Mr. Edwards joined A.S.M. in 1948 and has been very active in chapter work, having served on the education, entertainment and program committees, and as vice-chairman in 1958. He is a member of the Institute of Metals, London, and the Association of Professional Engineers, Ontario. Lighter interests are swimming, duck hunting and photography. He has a family of three daughters and a son.

C. C. Patton

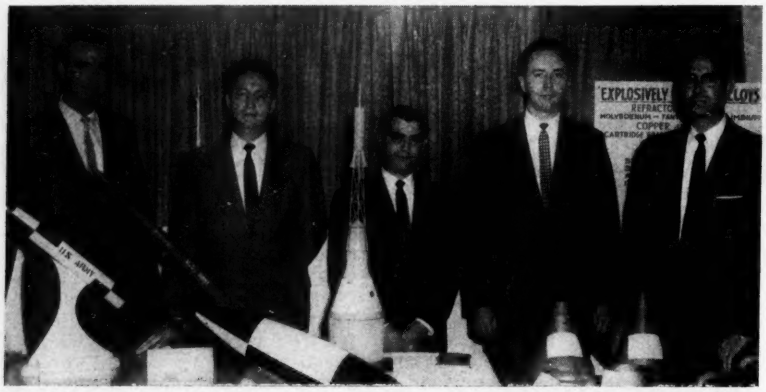


R. F. Schaffer

J. O. Edwards

J. M. Carrera

G. P. Michalos



Speakers at St. Louis Chapter's Seminar on "Missiles—Design and Material" Included, From Left: Conrad L. Busse, Moderator; Clarence M. Kowert, Emerson Electric Co.; J. P. Olevitch, Universal Match Corp.; Fred Sanders, McDonnell Aircraft Corp.; and C. O. Williams, Olin Mathieson Corp.

At St. Louis' Seminar On Missiles

At the **St. Louis Chapter's** first monthly meeting of the year, 125 people in attendance heard a seminar discussion on "Missiles Design and Material".

The seminar moderator was Conrad L. Busse, Guided Missile Branch, St. Louis Ordnance District. The Ordnance Corps is in charge of development, direction, and manufacture of Army weapons, including all ballistic missiles.

Clarence M. Kowert, chief, Missile Development Division, Emerson Electric Co., spoke on "Honest John Missiles". He discussed the design, development and production of the Honest John, the Improved Honest John and the Little Honest John Rockets. Colored movies of the rockets in actual firing tests made at the White Sands Missile Range were shown. Mr. Kowert explained that the accuracy problem is a ballistic problem, rather than a remote control problem (like a guided missile).

Jack P. Olevitch, project staff engineer, Armament Division, Universal Match Corp., talked on "Launching Pads and Launchers". He described the design and problems involved in delivering to the Navy a missile launcher of comparatively radical design. Problems of weight reduction and application of aircraft design and stress procedures to shipboard armament represented a departure from naval design concepts. Quality control and manufacturing difficulties met as the result of light metal and honeycomb construction and the solution to these problems were related.

Fred Sanders, project stress engineer, McDonnell Aircraft Corp., described "Project Mercury". Mr. Sanders explained designing, testing and building of the first "space capsule". This space capsule has been designed to hold a man for the first manned vehicle into orbit around the earth and to bring him back alive.

Among the factors considered were temperature, vibration, high acceleration, solar radiation, heat (the side away from the sun is extremely cold), the re-entry (which gives intense heat) and impact (a very high shock load).

The materials used in the space capsule cover the spectrum of all metals—from cobalt steel, stainless steel bolts, titanium steel and aluminum inside.

Charles O. Williams, acting manager, East Alton Ammunition Research and Development, Winchester Western Division, Olin Mathieson Chemical Corp., spoke on "Explosive Forming".

The advent of the missile and nuclear age required new needs and ideas for metals. These metals must withstand higher stresses, higher temperatures, and often highly corrosive conditions. The conventional types of metal forming proved unsatisfactory for forming these metals to the close tolerances and intricate shapes required by the design engineers.

Mr. Williams described the two types of metal forming: low-pressure forming (100 to 50,000 psi.) and high-pressure forming (2½ to 3 million psi.).

In low-pressure forming the die is closed and when an explosive is fired, these explosive gases are confined in the closed system and their energy is used to force the metal to form against the shape of the closed die.

High-pressure forming (in open dies) can either be accomplished by forming over a male die, or in a female die, or in rare cases, even without a die, utilizing the forces generated by the detonation of the high explosive.

Explosive forming decreases the initial tooling costs compared to old standard methods of manufacturing. Copper and steel can be made harder by explosive forming than by a 95% reduction by cold rolling. Explosive forming increases and improves the physical properties, extends the range of metal forming and makes possible forming of alloys which up to now could not be formed.

In this era of guided missiles, there is still a great deal of work to be done in the metals field. In addition to new materials, we must fully utilize known materials and extract further properties from them. **—Reported by David E. Murray for St. Louis Chapter.**

Machining Efficiency Is Topic at West Michigan

Speaker: H. J. Siekmann
General Electric Co.

H. J. Siekmann, senior research engineer, General Electric Co., at a meeting of the **West Michigan Chapter** spoke on "An Easy Approach to Machining Efficiency". He outlined easier methods of finding best cutting speeds for maximum production efficiency and/or minimum production cost by utilization of the Hi-E principle.

Initially, the Hi-E range was obtainable from charts representing optimum cutting speeds with the range falling between the lowest point of a total cost-per-piece curve and that of a total-time-per piece curve.

More recently, however, a new and simpler method for calculating the Hi-E range has been developed. A simple equation is solved to find the tool life that will result in minimum cost per piece and another equation gives the tool life for maximum production. The answers are then converted into cutting speeds by reference to a chart representing "tool life versus cutting speed". This chart gives the boundaries of the Hi-E range in terms of feet per minute.

Additional information is available from these calculations, such as correct cutting speeds for current machining operations and indications of what can be done to reduce costs and improve production rates in general. **—Reported by J. M. Ferrell for West Michigan Chapter.**

Lectures on Fracture of Materials

Earl Parker, University of California, Lectured on "Fracture of Materials" at the National Officers Night Meeting of the San Diego Chapter. Present were, from left: John V. Long, Cyril Madden, chairmen; Dr. Parker; and Stanley Carpenter, vice-chairman. (Photo by Phil Raney)

Speaker: E. R. Parker
University of California

Earl R. Parker, chairman, Division of Mineral Technology, University of California, and A.S.M. national trustee, presented an informative talk on A.S.M. headquarters activities and a technical report on "Fracture of Materials" at the National Officers Night meeting of the **San Diego Chapter.**

Although many practitioners may believe there are hundreds of ways for metals to fracture, Prof. Parker stated that there are really only five: shear; cleavage; fatigue; intergranular cohesion failure; and intergranular stress corrosion. Each mode of fracture is physically distinct and separate from the others and this concept has been a significant stride in characterizing the five types. Accordingly, recent years have seen fracture studies graduate from a classical descriptive study to a quantitative mechanistic understanding with greater promise for making progress in the field.

Prof. Parker explained low-temperature brittleness in steel on the basis of cleavage operating instead of shear. Each pit studied established the operation of (110) shear in tough fractures and (100) cleavage planes in brittle behavior. By blending atomic structure concepts with methods of analytic mechanics, modern researchers reached a satisfying understanding of the phenomena operating. Dislocation theory postulated the nucleation of a crack by a pile-up of dislocations where an active slip system crosses a previously slipped band (atomic structure concepts). The crack nucleus then is treated analytically as a notch, showing a theoretical normal stress level of about 2×10^6 psi. (methods of analytic mechanics). From this point, crack growth and propagation are straightforward, giving a more nearly complete understanding of brittle behavior.

The speaker pointed out that the purely theoretical dislocation concepts of 1934 persist today, even though it was 1950 before research tools permitted dislocation phenomena to be seen. His slides documented this milestone in mechanical metallurgy.

Fatigue events were explained by the formation of surface notches or extrusions as a result of step-wise deformation reversed by each cycle. Here again, actual electron micrographs support the theoretical concepts of crack nucleation and growth. High-temperature cracks evolved from polyhedral grain surface sliding, again with photomicrographic evidence. Stress corrosion knowledge is growing through studies of the Si-O bond in other systems, and direct experimental evidence may soon appear to establish the mechanism of bond rupture in metals undergoing stress corrosion.—**Reported by Walter Troy for San Diego.**

Uses of Heat Treatment Atmospheres Are Covered

Speaker: R. J. Light
Surface Combustion Corp.

The first meeting this season of the **Tri-City Chapter** featured a talk by R. J. Light, supervisor, metallurgical and chemical laboratory, Surface Combustion Corp., on "Heat Treatment Atmospheres".

Mr. Light outlined several varieties of carrier gas generated both exothermically and endothermically from mixtures of air and natural gas. He concentrated principally on the endothermic carrier gas preferred by most production men, which has the approximate analysis of 40% H_2, 20% CO and 40% N_2. For this gas to be in equilibrium with a material in respect to the carbon content of the surface, the ratios of CO to CO_2 and H_2 to H_2O must both be satisfied. The easiest method of control is by means of dewpoint. The chemical equations involved were shown and laboratory tests were reported which confirmed the calculated values of dewpoint versus percentage carbon at various temperatures. Automatic dewpoint recording and control within $\pm 2°$ was described. Besides dewpoint, other important factors in atmosphere control are time, temperature, the diffusion rate of carbon in steel and tight furnace construction.

R. J. Light

The value of high-temperature carburizing for medium to heavy cases was discussed. Necessary for this application are a stable carrier gas, controlled additions of natural gas, control of temperature, tight furnace construction, and zone control. Carbonitriding was briefly described as was the use of carbon restoration for hot rolled shapes and the use of homogeneous carburizing for raising the carbon level throughout steel strip.—**Reported by Earl M. McCullough for Tri-City.**

Gives Campbell Lecture At National Metal Show

Alexander S. Troiano, professor and head of the department of metallurgy at Case Institute of Technology, was elected to deliver the annual Campbell Memorial Lecture of the American Society for Metals during the 41st National Metal Exposition and Congress in Chicago.

The subject of Dr. Troiano's talk was "The Role of Hydrogen and Other Interstitials in the Mechanical Behavior of Metals".

The lecture, a feature of the Society's Annual Meeting, was given at 10:30 a.m., Wednesday, Nov. 4, in the Grand Ballroom of the Hotel Sherman in Chicago.

Describes Cases of Why Metals Bust

William M. Baldwin, Jr. (Left), Case Institute of Technology, Who Gave a Talk Entitled "Why Metals Bust" at a Meeting in Pittsburgh, Is Shown With George Hanna, Case Institute Student; and Gilbert Soler, Chairman

Speaker: W. M. Baldwin, Jr.
Case Institute of Technology

W. M. Baldwin, Jr., Case Institute of Technology, spoke on "Why Metals Bust" at a meeting of the **Pittsburgh Chapter.**

The three cases of metal failures discussed were those associated with rate of deformation, dislocations and hydrogen embrittlement.

For his first case Dr. Baldwin discussed the effect of rate of deformation in the cold heading of bolts made of 302 stainless steel and AISI 1038 steel. A plot of speed of deformation versus cold heading limit revealed that 302 stainless is far more ductile than 1038 steel at strain rates associated with ordinary tensile testing (approximately 1 in. per in. per min.), but as the strain rate increased the ductility of the 302 stainless decreased rapidly until, at a strain rate of 19,000 in. per in. per min., it was far more brittle than 1038 steel. Dr. Baldwin offered the hypothesis that 302 stainless might conceivably approach the ductility of glass should the rate of deformation be increased sufficiently.

The second case presented was that of metal failure associated with dislocations described as slip lines in which the metal above is compressed and the metal below is stretched. Using color slide illustrations depicting results of tests conducted at various temperatures, Dr. Baldwin explained how impurities diffuse into dislocation sites and effect the ductility of metals.

The ductility of a metal reaches a maximum in those tests conducted at low temperatures at which the dislocation can free itself from impurities. The tests conducted at high temperatures produced a smooth curve when the diffusion rate was increased to the extent that the dislocation could no longer free itself from the impurities. At intermediate temperatures the serrated curve resulted from the dislocation freeing itself from impurities and picking up additional impurities. These intermediate temperature ranges are those generally associated with "blue brittleness".

The final case of metal failure discussed was that due to hydrogen embrittlement. As little as 6 ppm. of hydrogen has been found to be detrimental to steels that exhibit ultrahigh strength.

Dr. Baldwin went on to explain the effect of hydrogen on the ductility of steel with the aid of three-dimensional slides on which were plotted temperature, strain rate and ductility. The ternaries show the formation of a valley as the testing temperature is increased—the ductility decreases to a minimum, then rises.

During the testing of these steels the hydrogen is present in solid solution and in the voids. As testing proceeds the size of the voids increases, thus reducing the pressure of the hydrogen and allowing additional diffusion into the voids. At a given temperature an increase in the strain rate will be accompanied by an increase in ductility when the rate of increase in the size of the void exceeds the rate of increase of diffusion of hydrogen into the void, decreasing the concentration of hydrogen in the void.—**Reported by J. B. Barr for the Pittsburgh Chapter.**

Discusses Welding of Alloy Steels

"Welding of Alloy Steels" Was the Topic Discussed by W. D. Doty, U. S. Steel Corp., Applied Research Laboratory, at a Meeting Held by the Mahoning Valley Chapter. Shown are, from left: K. L. Fetters, chairman; Dr. Doty; and P. T. Kelley, technical chairman of the meeting

Speaker: W. D. Doty
U. S. Steel Corp.

Members of the **Mahoning Valley Chapter** heard W. D. Doty, U. S. Steel Corp., speak on "Welding of Alloy Steels". Dr. Doty is division chief of bar, plate and forged products, Applied Research Laboratory.

In his presentation, the major welding processes and factors important to the weldability of alloy steels were reviewed. Methods for evaluating weldability were discussed and the development of a new high-yield strength alloy steel for welded structures was described.

Dr. Doty also described a severe test being used at the Applied Research Laboratory to evaluate the impact resistance of welded pressure vessels. The test consists of dropping a 13-ton ingot on a refrigerated pressure vessel. The ingot is dropped from successively higher heights until failure occurs. Some pressure vessels have been observed to withstand drop heights as high as 100 ft.—**Reported by Richard H. Rein for Mahoning Valley Chapter.**

Schedule Course in Toronto

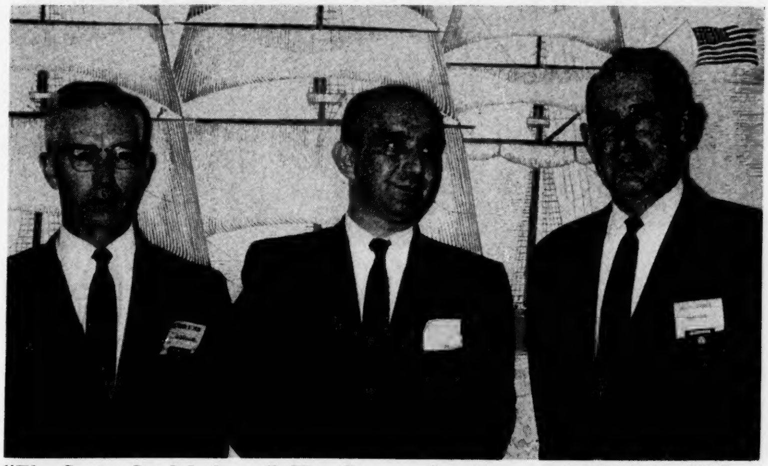
A series of ten lectures on "Physical Metallurgy—The Oxidation and Corrosion of Metals" are being given at the University of Toronto, Division of University Extension. The course started on Oct. 6, and will be held each Tuesday evening at 7:30 p.m. through Dec. 8.

Lecturer W. W. Smeltzer, department of metallurgy and metallurgical engineering, Hamilton College, McMaster University, will cover the science of corrosion processes occurring in dry and aqueous environments, laws of oxide film and scale growth on metals in dry atmospheres, oxidation characteristics of different metals and alloys, and electrochemical and metallurgical principles underlying aqueous corrosion.

These principles will be augmented by examples such as intergranular, pitting and stress corrosion, behavior of passive films, inhibitors and protective coatings.

Information about the above course can be obtained from: Room 207, 65 St. George St., University of Toronto, Division of University Extension, Toronto, Ontario.

Compares U.S. to Soviet Steel Industry



"The Soviet Steel Industry" Was Compared to That in the U. S. by Michael O. Holowaty, Inland Steel Co., at a Meeting of Peoria Chapter. Shown are, from left: T. W. Peck, heat treat manager, Caterpillar Tractor Co.; Dr. Holowaty; and A. H. Sommer, vice-president of the Keystone Steel and Wire Co.

Speaker: M. O. Holowaty
Inland Steel Co.

Michael O. Holowaty, chief research engineer, raw materials, Inland Steel Co., presented a talk on the "Soviet Steel Industry" at a meeting held by **Peoria Chapter.**

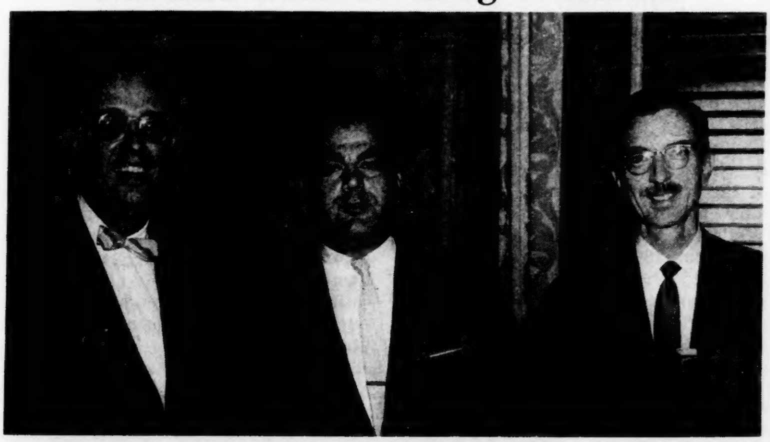
Dr. Holowaty indicated that the U.S.S.R. is somewhat ahead of us in blast furnace applied technology; however, they do not have the quality control at the operating level that we have. The U.S.S.R. has excellent blast furnace operations because they unhesitatingly spend money on research and obtain top-notch men to carry out any research that they feel is necessary. We have accomplished much of the research ourselves, but the Soviets have applied all of the improvements in one operation.

Dr. Holowaty pointed out that the directors of Russia's steel mills were communist party members, excellent administrators and good technical men. They could export 50% of their steel production without any noticeable reaction from the population. We are facing tough competition and we are not always drawing individuals of the highest abilities into the scientific fields as the U.S.S.R. is doing. Finally, the U.S.S.R. has another advantage because they have no strikes.

The speaker pointed out the tremendous difference in the living standards between the U. S. and the U.S.S.R. which might force the rulers of the Soviet to produce more consumer goods in the near future.

The meeting was concluded with the showing of 71 slides of Russia's countryside, the major cities visited, historical markers, museums and other places of interest.—**Reported by T. M. Walton for Peoria.**

Reviews Heat Treating Problems



N. O. Kates, Lindberg Steel Treating Co., Presented a Talk on "Minimizing Heat Treat Problems" at a Milwaukee Meeting. Shown are, from left: R. T. Duffy, technical chairman; Mr. Kates; and P. C. Rosenthal, chairman

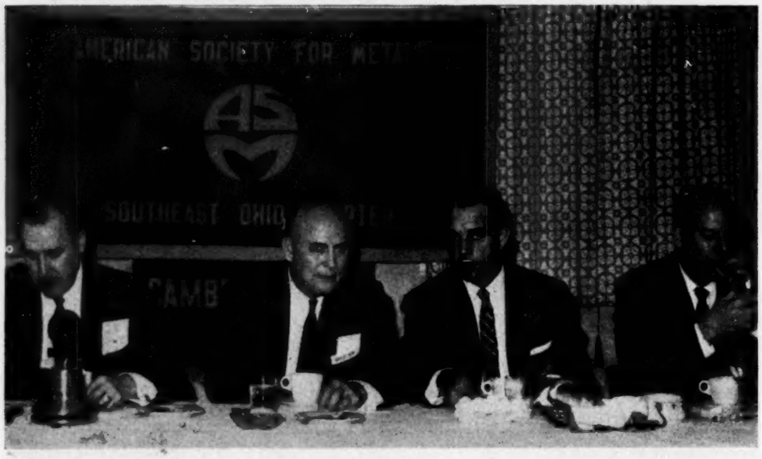
Speaker: N. O. Kates
Lindberg Steel Treating Co.

The kick-off meeting of the **Milwaukee Chapter** was sparked by Norman O. Kates, chief metallurgist, Lindberg Steel Treating Co., with his discussion on "Minimizing Heat Treat Problems".

Mr. Kates stressed co-ordination between engineering, purchasing, fabrication and heat treating groups as one of the most effective ways to limit or control problems in heat treating. This main theme of co-ordination was emphasized by Mr. Kates in various ways. The design engineer can contribute to the reduction of heat treat problems by proper consideration of size, shape and other geometrical aspects of the part. This will usually relieve many of the distortion problems which result from drastic changes in section. Fabrication people can aid the heat treater by proper removal of excess material, elimination of scratches, notches and decarburized surfaces and removal of mill scale. The heat treater can reduce his problems also by maintaining his equipment in top condition. The proper supporting and fixturing of parts for heat treatment can play an important part in the quality of the finished piece.—**Reported by John F. Hinrichs for Milwaukee.**

A.S.M. is the largest publisher of books for the metals industry in the world.

Tells How Ferrosilicon Alloys Are Made



A. F. Sprankle, Then Chairman, Olin L. Rutledge, Zanesville Steel Treating Co., Evan J. Davis, Interlake Iron Corp., Who Spoke on "Manufacture of Ferrosilicon Alloys", and A. D. Gate, Interlake Iron Corp., Are Shown During a Meeting Held by the Southeast Ohio Chapter Early This Year

Speaker: Evan J. Davis
Interlake Iron Corp.

Evan J. Davis, electric furnace superintendent, Interlake Iron Corp., discussed the "Manufacture of Ferrosilicon Alloys" at a meeting of **Southeast Ohio Chapter.**

Mr. Davis stated that the Jackson plant produces ferrosilicon containing from 6-85% silicon. Ferrosilicon containing less than 16% silicon is produced in a blast furnace. The blast furnace plant in Jackson has been in existence since 1872 and the present furnace is the fifth one which has been erected on the site.

The raw materials used in blast furnace production of ferrosilicon are iron ore, coke and limestone. Quality of product is maintained by proper control of slag volume, slag basicity and smelting zone temperature. The temperature in the smelting zone ranges from 2750 to 3200° F. With proper control, most of the impurities in the iron ore can be slagged off.

Ferrosilicon containing over 16% silicon is produced in an electric furnace at Jackson. The furnace charge consists of gravel quartzite, coke, coal and steel turnings. Impurities are kept at a minimum by use of high-purity gravel quartzite and by selection of steel turnings which are low in alloying elements, particularly chromium. Rapid determination of the impurity content is made possible by means of a spectrograph. While all grades of ferrosilicon ranging from 16-85% silicon have been produced, the major tonnage of this plant has been in the 50-75% grades. **—Reported by H. W. Rathmann for Southeast Ohio Chapter.**

New Films

Handling Materials in the Steel Industry

The Link-Belt Co. has produced a 25-min. color and sound film showing the wide range of equipment used in steelmaking, which is available from the Public Relations Dept., Prudential Plaza, Chicago 1, Ill.

Science Film Program

Bell Telephone Laboratories are making the following audio-visual aids to science education available:

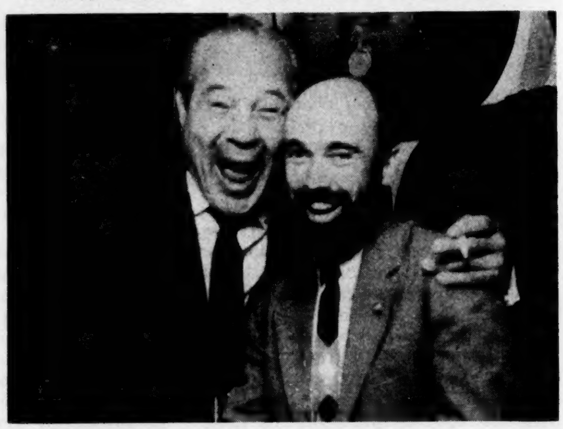
"Crystals—An Introduction", a 16-mm., 25-min. color, sound film, which provides an introduction to crystallography for electrical engineering students; "Brattain on Semiconductor Physics", a 16-mm., 30-min., black and white, sound motion picture in which Walter H. Brattain, Nobel Laureate in Physics, gives a lecture on the physics of semiconductors; "Submarine Cable System Development", a 16-mm., 18-min. sound, color film, describing the work of mechanical engineers in designing and developing underwater communication systems; "Zone Melting", a 45-min., 133-frame color filmstrip with narration on two 33 1/3-rpm. records, which deals with the new method of ultra-purifying solids and controlling the distribution of impurities in solids; "The Formation of Ferromagnetic Domains", a 45-min., color, 123-frame filmstrip, with narration on two 33 1/3-rpm. records, discusses the physical principles of domain formation; and "The Science of Sounds", a 90-min. record album which demonstrates 19 different acoustical phenomena.

These materials are available without charge through local Bell Telephone Co. offices.

Greets Philadelphia Chairman

Shown Presenting a Past-Chairman's Certificate to Outgoing Chairman Charles Turner, Jr., Is Fred Cooper, Incoming Chairman of Philadelphia Chapter

Max Baer Visits Sacramento



Guest of Honor Max Baer, Former World Heavyweight Champion, Is Shown at a Meeting of the Sacramento Valley Chapter With 1959-60 Chairman E. R. Mertz

Tells Rochester How to Stop Corrosion on Corrosion-Proof Items

Speaker: H. H. Brown
Eastman Kodak Co.

Henry H. Brown, metallurgical consultant, Eastman Kodak Co., Kodak Park Works, presented a talk on "Stopping Corrosion of Corrosion-Proof Equipment" at a meeting of the **Rochester Chapter.**

Industry is faced with a yearly six billion dollar loss of equipment by corrosion. The selection of material with the right chemical analysis and physical properties, and then proper fabrication, will greatly reduce this loss. The Germans in the 1920's pushed the AISI 400 series; the AISI 300 series started in the 1930's. At that time it was nearly impossible to get below 0.08% C, but molybdenum was added later to avoid pitting attack.

The introduction of the electric furnace enhanced the AISI 300 series. The furnace supplied a lower carbon than 0.08% and carbide precipitation was minimized. Thus, welding could successfully be used on the 300 series steels. In the late 30's many of the 300 series steels in use today were developed.

A 2 to 3% addition of molybdenum was found to combat sulphides in the paper industry, and AISI D319 (0.07% C max., 17.5 to 19.5% Cr, 11 to 15% Ni) was found to be satisfactory for photographic and chemical processors.

Galling has sometimes been a problem in the application of the 300 series stainless steels. Precipitation hardening stainless steels were introduced to overcome the galling problem and, at the same time, supply good corrosion resistance. Precipitation hardening types, equivalent to AISI 302, have been tested at Kodak for the past 7 or 8 years. In some cases they show merit comparable to the 300 series.

Several factors are sometimes overlooked in design and application. Alloys in themselves vary in resistance to corrosion—chemical analysis plays a large part in the corrosion resistance of some alloys. Physical structure also determines its merits against corrosion resistance. Both should be considered for particular chemical applications. Many alloys have to be used in the annealed condition.

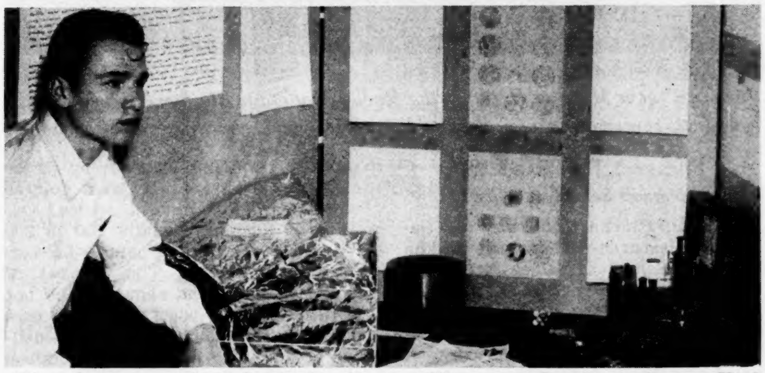
Intergranular corrosion damage can happen by continual corrosive attack, leaving a flexible metal held together by its grains alone. The so-called cement between the grains has been dispersed. Welding can start intergranular corrosion. Carbide precipitation is started between 800 and 1550 to 1600° F. Carbon precipitates out of solution and, with its affinity for chromium, causes chromium to come out of the grain and form chromium carbide. Stabilization with columbium and titanium, or the use of a low carbon AISI 304L (0.03% C max.) can stop a great deal of carbide precipitation.

Mr. Brown explained that stress corrosion is recognized by transgranular corrosion cracks in the 300 series. Tests should be conducted to determine if the material will be subject to stress corrosion.

Several enlightening examples of pitting corrosion were illustrated. One was a tube which had not been completely welded on the inside. Water went through the pipe and was sucked into the crack, the oxygen content was reduced in the stagnant water in the crack and electrolysis was set up. Corrosion increased nearly all the way through the pipe.

In conclusion, Mr. Brown stated that the 300 series, when properly used, will give satisfactory results. Choose the proper analysis and fabrication methods. He stressed duplicate designing and fabrication of the installation, if at all possible, before proceeding with a costly project.—**Reported by Joseph V. Hurley for Rochester Chapter.**

Wins Science Fair Award



Allan Gavere, a Ninth-Grade Student in Albert Lea Southwest Junior High School, Above, Was Awarded a Purple Ribbon First Prize for Junior High School Students at the State Science Fair for His Exhibit on Metallography. Allan's project was a study of the ternary diagram, bismuth, tin, and cadmium. His study involved making cooling curves of the various alloys and studying their microstructure after he had polished and etched them. This year Allan wrote to the University of Minnesota asking for information and help to carry on his project and was given the loan of a potentiometer and metallographic microscope by the University. Allan hopes to attend M.I.T. to study nuclear physics after graduation from high school

Presents Story of the Cutting Edge at Warren

Speaker: C. G. Schelly
DoALL Co.

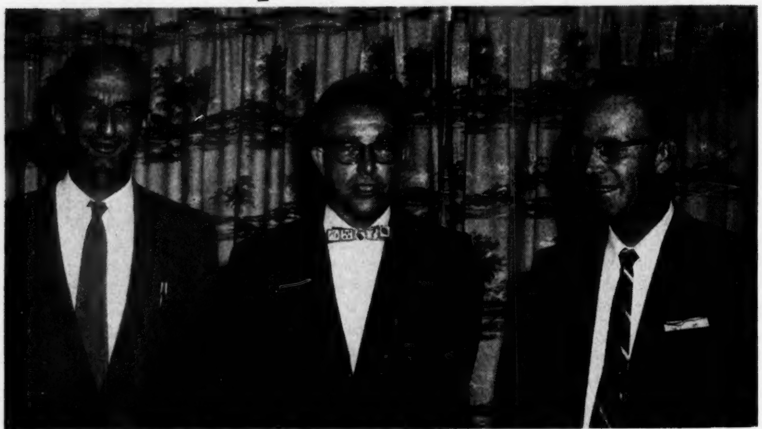
C. G. Schelly, director of educational research for the DoALL Co., presented an illustrated talk, "The Story of the Cutting Edge", at a meeting of the **Warren Chapter.**

The chronological listing of the evolution of the cutting edge as compared with man was illustrated with pictures and mounted specimen examples, starting with the first edge used by humans, the bone. This crude instrument came into use some 1,000,000 years ago. The story then progressed through the special-purpose tool stages of development until the first metallic edge of copper was introduced 6500 years ago. Metallic edges had their beginnings with the people of the valleys of the Tigris and Euphrates Rivers. The second metallic edge, bronze, followed copper and in 3200 B.C. the first iron cutting edges were developed.

Mr. Schelly stressed the similarity and interdependency of the development of the human and the development of the cutting edge. Approximately 150 years ago the first machine tools were invented, the forerunners of today's multimillion dollar industry. The use of mechanically controlled cutting edges was one of the most important phases of our industrial revolution.

Proceeding to more modern applications, Mr. Schelly listed the five most important considerations of the cutting tool designer: edge to be used; method of use; material to be cut; cutting fluid; and the machine's and the operator's capabilities. A series of slides illustrated the more technical aspects of tool design. Pictures of blade rake angle, tool speed and consequent chip breakage and color showed the great need for balance between the five previously mentioned considerations.—**Reported by John E. Cleary for Warren.**

Outlines Explosive Forming Methods



John S. Rinehart (Center), Presented a Discussion on "Explosive Metal Forming" at a Meeting Held by the Rocky Mountain Chapter. Shown are the technical chairman, Doug Bainbridge (left), and chairman, Dick Schaefer

Speaker: J. S. Rinehart
Colorado School of Mines

John S. Rinehart, director of the Mining Research Laboratory at the Colorado School of Mines, presented a talk on "Explosive Metal Forming" at a meeting of the **Rocky Mountain Chapter.** Dr. Rinehart, recipient of a Presidential Citation for his work on proximity fuses during the last war, is co-author of a book, "Behavior of Metals Under Impulsive Loads".

He described the various types of explosives that may be used. These vary from the low or slow-burning variety to the high explosives, which, when detonated, may exert as much as four to five million pounds per square inch pressure upon an object in intimate contact with the explosive. The talk went on to show the behavior of metals under the high rates of loading caused by these extreme pressures. It was pointed out that metals have a critical velocity of forming, usually 100 to 200 ft. per second, which cannot be successfully exceeded. The amount of explosive used was shown to be not critical, but it was explained that placement of the charge and the medium surrounding it was of importance. Forming in the free state and with the use of dies was also discussed.

Dr. Rinehart went on to review the uses and potentialities of explosive forming. One interesting use of the method is in the hardening of manganese steel dipper teeth on power shovels. The process is done in the field by detonating explosive in intimate contact with the teeth. This causes work hardening and results in a 30% extension of life.—**Reported by L. G. Loseke for Rocky Mountain.**

Metallurgist South of the Border

Shown Receiving His Degree in Metallurgical Engineering From Universidad Industrial de Santander, Bucaramanga, Colombia, Is Luis F. Solano Puyana (Right). Rodalfo Low Maus, rector of the University presents the certificate while Ciro Duarte, dean of the faculty, and J. Ramirez Munoz, chief, department of scientific investigation, look on

Describes Slip Casting At New Jersey Meeting

Speaker: L. M. Schifferli
Haynes Stellite Co.

Members of the **New Jersey Chapter** heard a talk on "Slip Casting" by L. M. Schifferli, Jr., development and technical services department, Haynes Stellite Co.

Slip casting is a form of powder metallurgy in which the metal powder, a liquid and a deflocculant are poured as a slurry or slip into a plaster mold. Casting is done at room temperature as compared with temperatures above the melting point of the metal in conventional casting processes. At shakeout the part is relatively weak with a fine grain, whereas the ordinary metal casting is strong and has a medium-to-coarse grain size. The slip casting has a porous structure and a smooth surface as opposed to density and roughness in its metal counterpart.

A molding comparison shows that the expendable cores of metal casting have a permanent counterpart in slip casting, and slip casting molds may last for 50 parts, while the sand, shell or investment molds used with hot metals are, of course, destroyed during shakeout. Since a slip casting is poured at room temperature, the setting action is accomplished through absorption of the liquid by the plaster mold rather than by freezing.

Mr. Schifferli explained that the properties of the slip before and after sintering depend on the liquid-to-metal ratio, and the amount and type of deflocculant used. Parts made by the process are limited in some degree to a certain symmetry. While there have been only a few special alloys successfully slip cast, the process holds promise for refractory metals.

Mr. Schifferli's address included slides and an interesting display of parts made by the process.—**Reported by S. W. Sokolowski for New Jersey.**

Explains Residual Stresses At West Michigan Meeting

William G. Johnson, general supervisor in charge of basic production engines, Caterpillar Tractor Co., spoke at a meeting of **West Michigan Chapter** on "Residual Stresses Due to Heat Treatment and Casting".

Mr. Johnson covered the basic fundamentals involved in residual stresses produced by heat treating and casting, as well as residual stresses due to induction hardening. Heat treating of a crankshaft and a large final drive gear were also explained. Stresses in a cast iron cylinder block were described, with details of how a field problem was solved by proper attention to design and cooling.—**Reported by Donald J. Gerken for West Michigan.**

1960 Metal Show Geared To Membership Demands

Although a most successful American Society for Metals' Congress and Exposition has just been concluded in Chicago, extensive plans have already been made for a 1960 Metal Show that will be shaped to meet, even more than in the past, the timely demands of the A.S.M. membership.

"For example", said Allan Ray Putnam, managing director, "we have found that A.S.M. members have an urgent need for a straight-line channel of communication with the producers of metals, with the technical and sales executives who can provide specific answers to specific problems on specific applications.

"For many years, the technical sessions of the Society have dealt broadly with these general metals problems. However, the specific answers must come from the experts.

"As a result of these membership needs", continued Putnam, "every effort is being made to present this type of information in the technical exhibits in Philadelphia. In fact," he concluded, "the spotlight will be on metals, and on steel in particular, in the plans that are underway for the 42nd National Metal Congress and Exposition in Philadelphia, the week of Oct. 17, 1960".

As plans for the 1960 meeting develop with a resurging emphasis on metals, more comprehensive information will be announced for the thousands of A.S.M. members who have expressed a deep interest in this important metals activity.

West Michigan Officers Plan Program

Shown at a Meeting of the Program Planning Committee of West Michigan Chapter Are, From Left: H. J. Wassink, Professor of Engineering and Physics, Calvin College, Chairman of the Education Committee; Charles E. Laitsch, Manager of Engineering, Grand Rapids Brass Co., Chairman; Richard F. Haskins, Chief Metallurgist, Universal Joint Division, Rockwell-Standard Corp., Vice-Chairman; and C. C. Dierdorf, Metallurgist, Keller Tool Division, Gardner-Denver Corp., Secretary-Treasurer

Speaks on Properties and Some Applications of Gold

Speaker: N. S. Spence

Dept. of Mines and Technical Surveys

Members of the **Ontario Chapter** heard N. S. Spence, head of the Nuclear Metallurgy Section, Dept. of Mines and Technical Surveys, Ottawa, give a talk on "Gold Is Freely Available. Do You Use It?"

The historical role of gold in coinage, in decorative applications and as a symbol and instrument of wealth and power was reviewed and the properties of the metal which abet these uses were listed as distinctive color, ductility and corrosion resistance. Absence of oxide and sulphide tarnish assures that it maintains its high metallic lustre under all normal conditions.

Current industrial applications are based mainly on its good thermal and electrical properties and particularly on its corrosion resistance. The associated low and constant contact resistance, freedom from sticking and welding are all important in electrical applications. Its high, stable reflectivity to infrared leads to applications in the surfacing of satellites and optical goggles.

Gold is produced in the world at the rate of 1300 tons per year which is in excess of current production of selenium, tellurium, germanium, indium and gallium. However, it will undoubtedly remain expensive. Cost will tend to restrict metallurgical alloying additions to the range of 0.01 to 0.1%. The Mines Branch is currently investigating the possible effects of small amounts of gold in diffusion-controlled processes such as response to heat treatment and aging; the improvement in resistance to oxidation and other types of corrosion; the improvement of creep strength, fatigue resistance and the lowering of brittle-ductile transition temperature; and the improved workability of "difficult" metals such as molybdenum.—**Reported by J. S. Kirkaldy for the Ontario Chapter.**

Technical Papers Invited for A.S.M. Transactions

The Transactions Committee of the A.S.M. is now receiving technical papers for consideration for publication in the Transactions of the Society and possible presentation before the next national meeting of the Society, in Philadelphia, Oct. 17 to 21, 1960.

Many of the papers approved by the Committee will be scheduled for presentation on the technical program of the 42nd National Metal Congress and Exposition.

Papers may be submitted any time up to Apr. 15, 1960, for consideration for presentation at this convention. The selection of approved papers for the convention technical program will be made in May 1960. Manuscripts may be submitted any time during the year and upon acceptance by the Transactions Committee will be processed immediately for preprinting. All papers accepted will be preprinted and made available to any members of the Society requesting them. However, the printing of an accepted paper does not necessarily infer that it will be presented at the convention.

Reprinting of accepted papers is done quarterly; notification of their availability is published in *Metals Review*.

Manuscripts in triplicate, plus one set of unmounted photographs and original tracings, should be sent to the attention of T. C. DuMond, field secretary and program coordinator, American Society for Metals, Metals Park, Novelty, Ohio.

Should it be your intention to submit a paper, please notify A.S.M. A copy of the booklet entitled "Suggestions to Authors in the Preparation of Technical Papers" will be gladly forwarded. This booklet may help considerably in the preparation of line drawings and illustrations.

A. S. M. METALLOGRAPHIC AWARDS — 1959

Class 1—Cast Irons and Steels

Best in Class: Jiri Miksche, SVUMT, Brno, Czechoslovakia—An Inclusion With Graphite in Phosphide Eutectoid.

Honorable Mention: Robert R. Russell, Research Laboratory, General Electric Co., Schenectady, N. Y.—Bands of Discoloration Etch Pits Around a Crack in a Deformed Single Crystal of Fe-Si-C.

Class 2—Carbon and Alloy Steels (Wrought)

Best in Class: M. Hatherly and L. E. Samuels, Defence Standards Laboratories, Alexandria, Australia—Martensite in Lamellar Form in Fe-Ni-C Alloy.

Honorable Mention: H. G. Gearhart, Screw Corp., City of Industry, Calif. —Carbide Orientation in 0.05 Carbon Steel Stressed at Subcritical Temperature for a Long Duration.

Class 3—Stainless Steels and Heat Resisting Alloys

Honorable Mention: William C. Coons, Senior Research Metallurgist, Nuclear Dept., Reactor, Curtiss-Wright Corp., Quehanna, Pa.—Udimet 500 Polished on New Automatic Polishing Device.

Class 4— Aluminum, Magnesium, Beryllium, Titanium and Their Alloys

Best in Class: William C. Coons, Senior Research Metallurgist, Nuclear Dept., Reactor, Curtiss-Wright Corp., Quehanna, Pa.—Alpha-Beta Titanium, Variously Cooled.

Honorable Mention: Fred Sun and Ed Prohaska, Titanium Metallurgical Laboratory, Camcar Screw & Mfg. Co., Rockford, Ill.—Grain Flow Pattern in 4% Al, 4% Mn Titanium Alloy.

Class 5—Copper, Nickel, Zinc, Lead and Their Alloys

Best in Class: R. D. Buchheit, J. L. McCall and G. A. Wheeler, Battelle Memorial Institute, Columbus, Ohio—Zinc Antimonide Eutectic Viewed in Bright Field and Under Polarized Light.

Honorable Mention: V. V. Damiano, M. Herman and G. S. Tint, Franklin Institute, Philadelphia, Pa. — Zinc Single Crystal—Newton Fringes on Dissolution Etch Patterns.

Honorable Mention: Pierre P. Turillon and Gregory J. DeVito, Metals Div., Kelsey-Hayes Co., New Hartford, N. Y.—Interdendritic Ni_3Al in Cast Nickel-Iron-Aluminum Alloy.

Best in Show
Francis F. Lucas Award
F. M. Beck
General Engineering Laboratory
General Electric Co.
Schenectady, N. Y.
Crystal Growth and Structure of Magnesium Platino Cyanide

Class 6—Uranium, Plutonium, Thorium, Zirconium and Reactor Fuel and Control Elements

Best in Class: E. W. Filer, General Electric Co., ANP Dept., Cincinnati, Ohio—Reaction of Lanthanum Oxide With Yttrium.

Honorable Mention: William C. Coons, Senior Research Metallurgist, Nuclear Dept., Reactor, Curtiss-Wright Corp., Quehanna, Pa.—Aluminum-Clad UO_2Al Cermet Fuel Element Structures.

Class 7—Metals and Alloys Not Otherwise Classified

Best in Class: William C. Coons, Senior Research Metallurgist, Nuclear Dept., Reactor, Curtiss-Wright Corp., Quehanna, Pa. — Cadmium-Antimony Alloys Showing Beta Plus Gamma Eutectic Plus Primary Gamma Crystals.

Honorable Mention: Clifford C. Hartelius, Research Laboratory, General Electric Co., Schenectady, N. Y. — Sintered Columbium Infiltrated With 8% Silicon-Silver Alloy.

Class 8—Series Showing Transitions or Changes During Processing

Best in Class: James R. Dvorak, Metallographer, Armour Research Foundation, Chicago, Ill.—Interrupted Quenching of Titanium Alloy Containing 4% Al, 3% Mo and 1% V.

Honorable Mention: Nino S. Pites and R. P. Morenski, International Nickel Co., Inc., Research Laboratory, Bayonne, N. J.—Phase Transformation of Age Hardening High-Temperature Alloy (87.7% Ni, 12.2% Ti).

Honorable Mention: R. D. Buchheit and G. A. Wheeler, Battelle Memorial Institute, Columbus, Ohio—Aging of Cobalt Alloy With 15% Tungsten.

Class 9—Welds and Other Joining Methods

Best in Class: William C. Coons, Senior Research Metallurgist, Nuclear Dept., Reactor, Curtiss-Wright Corp., Quehanna, Pa.—Molybdenum Alloy Heliarc Welded to Tungsten.

Honorable Mention: Clarence R. Lehmann and Edward G. Littell, Materials Evaluation Unit, General Electric Co., Evendale, Ohio—Electron Beam Butt Weld in 18-8 Stainless Steel.

Honorable Mention: James H. Naser and Robert Timko, Jessop Steel Co., Washington, Pa.—Junction Between Two Type-310 Stainless Steel Weld Overlay Beads on and at Carbon Steel Base Metal.

Class 10—Surface Coatings and Surface Phenomena

Best in Class: John Knudsen and Jack A. Sartell, Honeywell Research Center, Hopkins, Minn.—Growth Facets on the Surface of Nickel Oxide Formed on 99.999+% Nickel at 1100° C.

Honorable Mention: Helen Henry, U. S. Bureau of Mines, Reno Metallurgy Research Center, Reno, Nev.—Etch-Pit Configuration in Differently Oriented Grains of Arc Melted Electrorefined Vanadium.

Class 11—Slags, Inclusions, Refractories, Cermets and Aggregates

Best in Class: R. E. Gardner and J. F. Richards, Avco Research and Advanced Development Div., Wilmington, Mass. — Highly Ordered Crystalline Graphite Deposited at High Temperature From a Methane-Hydrogen Atmosphere.

Honorable Mention: William C. Coons, Senior Research Metallurgist, Nuclear Dept., Reactor, Curtiss-Wright Corp., Quehanna, Pa.—High-Density Hot Pressed Beryllia (BeO).

Honorable Mention: Alex E. Wituszynski, Research Laboratory, General Electric Co., Schenectady, N. Y. —Bi_2O_3 Fractograph.

Class 12—Electron Micrographs

Best in Class: G. Henry, J. Plateau and C. Crussard, I.R.S.I.D., St. Germain-en-Laye, France — Microfractograph of the Cleavage Rupture Surface of Mild Steel Broken at −196° C.

Honorable Mention: Helmut Poppa, N.A.S.A. Structures Research Div., Langley Field, Va.—Ultrathin Single Crystal of Gold. (Micrograph taken at Laboratory of Electron Microscopy, University of Heidelberg, Germany)

Honorable Mention: Vincent M. Poynter, General Electric Co., Evendale Plant, Cincinnati, Ohio—Carbide Particle in Inco 702 Interfering With Slip in Matrix.

Honorable Mention: Andrew S. Holik, General Electric Co., Research Laboratory, Schenectady, N. Y.—Surface of Thermally Etched Stainless Steel.

Talks on Mechanical Behavior

E. E. Stansbury, University of Tennessee, Spoke on "Metallurgical Factors in the Mechanical Behavior of Metals" at Richmond. Shown are, from left: W. F. Smith, secretary; T. S. Daugherty, ways and means chairman; C. L. Brooks, vice-chairman; Dr. Stansbury; and J. A. Burke, Jr., chairman

Speaker: E. E. Stansbury
University of Tennessee

E. E. Stansbury, University of Tennessee, and National Trustee, A.S.M. presented a talk at the Officers Night Meeting of the **Richmond Chapter** on "Metallurgical Factors in the Mechanical Behavior of Metals".

Before presenting his subject, Dr. Stansbury gave the latest information on the new headquarters building of A.S.M. and showed several slides of construction details. Latest information on the Metals Handbook was also given.

Dr. Stansbury described the brazing operation of steel and simultaneous tempering around 1100° C. Problems of ductility were also mentioned. Free ferrite in steel was said to raise the transition range of brittle-to-ductile failure. Ductility is a function of aging due to soft material in a high-strength matrix. A series of slides supported Dr. Stansbury's views. Stress-strain curves at various temperatures showed flow and fracture stresses for a hot rolled, semichilled 0.2% carbon steel. The effects of testing temperature on tensile-yield strength and true fracture stresses for two carbon steels were shown. Schematic stress-strain curves of tempered martensite and pearlite were also presented.—**Reported by Patrick H. Woods for Richmond.**

Class 13—Results by Unconventional Techniques

Best in Class: Robert R. Russell, Research Laboratory, General Electric Co., Schenectady, N. Y.—Hexagonal Cells and Growth Terraces on the Solid-Liquid Interface of a Lead Single Crystal.

Honorable Mention: James A. Nelson and Joseph Rudolph, Materials Engineering Dept., Westinghouse Electric Corp., East Pittsburgh, Pa.—Neutron Activation Auto-Radiography of a High-Temperature Alloy.

Class 14—Color Prints

Best in Class: See Grand Prize (Best in Show)

Honorable Mention: B. C. Leslie, M. L. Picklesimer and J. C. Gower, Oak Ridge National Laboratory, Union Carbide Nuclear Co., Oak Ridge, Tenn.—Zirconium With 3 at.% Silver.

Honorable Mention: W. H. Tholke, Color print by J. E. Reagan, General Electric Co., ANP Dept., Cincinnati, Ohio — Zirconium Hydride — Phase Identification by an Anodizing Etching Technique.

Honorable Mention: L. E. Samuels and G. W. Westbury, Defence Standards Laboratories, Alexandria, Australia—Primary Dendrite of Cuprous Oxide in a Copper-Oxygen Alloy

Compliments

To WALTER R. HIBBARD, JR. manager of Alloy Studies Research, General Research Laboratory, on being re-elected a vice-president of A.I.M.E. Dr. Hibbard is a member of Eastern New York Chapter.

♦ ♦ ♦

To CARL E. BETZ, vice-chairman of the board of Magnaflux Corp., a member of Chicago Chapter, who was selected to deliver the 1959 Lester Honor Lecture at the Annual Meeting of the Society for Nondestructive Testing.

♦ ♦ ♦

To CARLETON C. LONG, director of research, St. Joseph Lead Co., on being elected president of The Metallurgical Society of A.I.M.E. Dr. Long is a member of Pittsburgh Chapter.

♦ ♦ ♦

To MORRIS COHEN, professor of physical metallurgy at Massachusetts Institute of Technology, and member of Boston Chapter, on being awarded the Francis J. Clamer Medal by the Franklin Institute for his investigation of the physical metallurgy of the heat treatment of steels.

♦ ♦ ♦

To R. H. LAMBERT, associate professor of metallurgical engineering, Carnegie Institute of Technology, on being chosen to head the newly formed Technical Council of the Society for Nondestructive Testing. Rear Admiral Lambert will organize and direct industrial methods and technical publications committees in this capacity. He is a member of Pittsburgh Chapter.

Canton-Massillon Grants Scholarship

Shown Is the Presentation of the Third Louis A. Zeitz Scholarship Award by Canton-Massillon Chapter Chairman, Wilbert W. Scheel, to the Winner, David S. Haley, Graduate of Hoover High School in North Canton. Looking on is Walter E. Littmann, Chairman of the Metallurgical Advancement Committee Which Made the Selection of the Winning Applicant. The $200 award was established by the Chapter as a memorial to the late L. A. Zeitz, an industrial engineer for East Ohio Gas Co., and secretary of the Chapter for several years. Dave plans to begin the study of metallurgical engineering this fall at Case Institute of Technology

Presents 25-Year Certificate

T. C. Jarrett (Right), of the T. C. Jarrett Co., Is Shown Being Presented a Silver Certificate for 25 Years of Continuous A.S.M. Membership, by Byron MacPherson, MacPherson Corp., past chairman of Rocky Mountain Chapter

Cites Developments in Metals Research at York

Speaker: R. H. Aborn
U. S. Steel Corp.

"Recent Developments in Metals Research" was the subject of a talk given by R. H. Aborn, director of the E. C. Bain Fundamental Research Laboratories, U. S. Steel Corp., and A.S.M. national treasurer, at the National Officers Night meeting of the **York Chapter.**

Dr. Aborn began by discussing some of the possible future trends in the manufacture of steel, such as direct reduction of ore, continuous processes for the manufacture of steel from ore and further increases in the use of oxygen.

One major aim will be for further reduction in impurity levels. Low impurities can contribute to new and greatly improved characteristics. Hydrogen control by means of vacuum casting or melting is already standard practice in certain critical applications where hydrogen-produced flakes in steel are detrimental to fatigue life. Nitrogen and oxygen are other impurities which are reduced to varying extents by the new vacuum melting process. Rare metals may entail vacuums as low as one ten millionth of normal atmospheric pressure.

Another important purification method is zone refining, already extensively applied commercially to semi-conductors. Applied to iron this process yields a product which retains high ductility to a few degrees above absolute zero. Low impurity levels are associated with ultra-high strength in metal "whiskers" which are on the order of 1 or 2 microns in diameter. However, present belief is that these properties are related more to the extremely low level of imperfections achieved and particularly to a very low level of surface imperfections.

Among the research tools which are important in contributing to our knowledge are the use of extremely high-speed motion pictures, the electron microscope to reveal structure units as small as one hundred atoms in diameter, and the microprobe analyzer to give X-ray spectrographic analyses of areas as small as 80 millionths of an inch in diameter.

Prior to the technical meeting Ted C. DuMond, field secretary A.S.M., gave an interesting and informative talk on Society affairs and plans for the future, as well as on the progress of A.S.M.'s headquarters building and the Metals Engineering Institute. **—Reported by William T. DeLong for York Chapter.**

Explains X-Ray Methods In Study of Residual Stresses at Albuquerque

Speaker: R. E. Marburger
General Motors Research Laboratories

Richard E. Marburger, senior research physicist, Physics Dept., General Motors Research Laboratories, spoke at a meeting of the **Albuquerque Chapter** on "X-Ray Diffraction Studies of Residual Stresses in Hardened Steel".

Mr. Marburger introduced his discussion by explaining X-ray diffraction principles, film stress techniques and geiger-counter diffractometer techniques. The diffuse, asymmetrical nature of the martensite lines in hardened steel complicates the measurement of residual stresses by means of X-ray diffraction. Mr. Marburger explained that early methods of measuring residual stresses in hardened steels by X-ray have been time-consuming. The stress measurement procedure described in this discussion, originated by Mr. Marburger and D. P. Koistinen, used a multiplicative correction to peak intensity which includes all significant geometrical and absorption factors. The line position is defined as the axis of a vertical parabola fitted to only three corrected data points. When compared with previous methods, the new procedure greatly reduces the time required to obtain data and make the necessary calculations.

When steep stress gradients are encountered, it is necessary to consider the penetration of the X-ray beam. Although the methods described were developed primarily for the measurement of macrostresses, the basic concepts utilized in the methods are applicable to the study of microstresses.

In the application of this stress measurement procedure, Mr. Marburger explained how this new stress measurement procedure, together with other X-ray diffraction techniques, makes it possible to study the origin and distribution of residual stresses beneath mechanically finished surfaces, beneath carburized surfaces and in the surface layers of through hardened steels. It is also possible to study the origin of stresses in decarburized surface layers. An additional application advantageously used the breadth of martensite diffraction lines in hardened steel to obtain a nondestructive superficial hardness measurement.**—Reported by Gerrit J. Hof for Albuquerque.**

Schedule Powder Metallurgy Conference for June 1960

The 1960 International Conference on Powder Metallurgy will be held at the Hotel Biltmore, New York, from June 13-15, 1960. One day each will be devoted to fundamentals and theory, to technology and methods, and to alloys, materals and applications. The purpose of the Conference is to provide an evaluation of the present status of powder metallurgy and its part in today's technology.

Chairmen of the Conference, sponsored jointly by the Metal Powder Industries Federation and the Powder Metallurgy Committee of the Metallurgical Society, A.I.M.E., are F. V. Lenel, Rensselaer Polytechnic Institute, and K. H. Roll, Metal Powder Industries Federation. J. L. Bonanno, Lionel Corp., chairman of the plant tours committee, has announced that tours will be organized among plants of powder producers, powder metallurgy parts manufacturers, compacting press and sintering furnace manufacturers for the two days following the Conference.

Further information can be obtained from: M.P.I.F., 130 W. 42nd St., New York 36, N. Y.

"Experts" Answer Queries On Heat Treating Problems

At a Stump the Experts meeting of the **Chicago Chapter,** John a Grodrian, director of factory and research laboratories, Bendix Aviation Corp., O. M. Haseltine, sales manager, Ajax Electric Co., Harry B. Knowlton, consulting metallurgist, and Norbert K. Koebel, director of research, Lindberg Engineering Co. served as the panel of experts who discussed "Heat Treating". J. D. Graham, chief engineer, materials engineering and engineering standards, International Harvester Co., acted as moderator. Carl A. Samans, associate director of engineering research, Standard Oil Co., presided as judge and determined the acceptability of the panel's answers.

Questioning centered about the always interesting and ever controversial subjects of high-temperature carburization, distortion, double normalizing, preferred methods of transforming retained austenite, stabilizing cycle in precipitation hardening, feasible operating temperatures for salt bath operation, controlled atmosphere heat treating, etc.—**Reported by G. W. Graves for Chicago.**

Southwest Show Set For May 9-13, 1960

One of the most intensive attendance programs in show history has been developed by the American Society for Metals in cooperation with 10 A.S.M. chapters throughout the South and Southwest for the 2nd Southwestern Metal Congress and Exposition in Dallas, May 9 to 13, 1960.

Under a program that will be launched Dec. 27 of this year, more than 2000 metalworking plants and their 600,000 employees in an 11-state area will be told again and again of the event that will bring some 200 industrial exhibitors to the State Fair Park.

"One of the fastest growing metalworking areas in the United States, the Southwest is a maturing industrial frontier of great importance to the nation's economy", said Allan Ray Putnam, managing director of the Society. "With its aircraft, instruments, metals and chemicals industries expanding so rapidly, the Southwestern Metal Show will meet the demand for production and engineering information of a rapidly expanding market".

Both the Exposition and the Congress, comprised of the technical sessions of a number of socieities and associations, will be shaped to the Southwest and its specific needs with the theme, "Metalworking Roundup —Southwest Brand".

Attendance promotion will include direct mail to industrial plants throughout the 11-state area, plant bulletin board posters, newspaper advertising in the 20 major metalworking cities and magazine advertising on a regional and national basis. Jack Stratton, who has handled publicity on the Western Metal Show for a quarter-century, will direct these activities for the Dallas event.

A substantial number of exhibitors have already reserved display space in the exposition hall at State Fair Park. "There is every indication", according to Chester L. Wells, exposition manager, "that this 2nd Southwestern Metal Show is regarded as an effective sales tool by industry nationally. Many firms have already established their markets in the southwest, and many others are taking this opportunity to become acquainted with the area and to begin the establishment of markets in this growing and maturing industrial frontier".

Because of the widespread interest in the attendance program, a descriptive brochure is being distributed to exhibitors and to prospective exhibitors both by mail and through the sales department of the American Society for Metals. Copies of the brochure can also be obtained by contacting A.S.M. Headquarters, Metals Park, Novelty, Ohio, or sales offices in New York, at 342 Madison Ave., New York 17, (Oxford 7-2667), and Chicago, 53 W. Jackson Blvd., Chicago 4 (WAbash 2-7822).

Describes Space-Age Metallurgy

Ted C. DuMond, Field Secretary A.S.M., Spoke on "Atomic and Space-Age Metallurgy" at a Meeting Held in Boston. Shown are, from left: James L. Martin, chairman; Mr. DuMond; Fredrick Teed, state supervisor, Massachusetts Div. of Vocational Education; and Albert Kaufman, technical chairman

Speaker: T. C. DuMond
Field Secretary, A.S.M.

Members of the **Boston Chapter** heard Ted C. DuMond, field secretary A.S.M., speak on "Atomic and Space-Age Metallurgy" at a recent meeting.

Mr. DuMond covered the impact or effects of atomic and space-age metallurgy. Textbook varieties of materials are gradually becoming common, new fabricating methods are rapidly surging and new inspection methods are becoming necessary. Schools are adopting materials engineering courses at the undergraduate level. The influence of both atomic and space-age metallurgy is likely to affect other industries (i.e., the use of irradiation on food for the purpose of food preservation). Some of the changes with which we are concerned include heat transfer properties, electrical properties, brittle-to-ductile transition, etc.

The emphasis today in the materials of the atomic and space age field is on degree of purity, on joining, and in nondestructive testing. For the sake of purity, the electron beam is being employed. In the field of joining, both the plasma jet and electron beam welding are coming into use. The metallic materials becoming popular are columbium, tantalum, chromium, molybdenum, tungsten, uranium and titanium. Other materials gaining popularity are cermets, plastics, combinations of metals and plastics and combinations of fiberglass and plastics.

Each new material brings new problems in fabrication. Therefore, new processes of fabrication are rapidly coming into use. These are explosive forming, which is being applied to extrusion, welding and hardening; plasma jet, which is being used for surface coating and welding; and ultrasonics, which is being applied to welding, cleaning and testing.

In summary, both atomic and space-age metallurgy areas put emphasis on purity (trifles such as small inclusions are becoming increasingly important), fabrication, and finally, improved and new methods of inspection. Maximum strength and minimum weight appear to be the main objectives. **Reported by Daniel A. Black for Boston Chapter.**

Named Metals Man of Year

John Trimble, Manager of Carbonyl Metal Products, the Budd Co., Spoke on "Gas Plating" at the Philadelphia Chapter's Delaware Valley Metals Man of the Year Award Night Meeting. Shown are Charles Turner, Jr. (left), and Walter Kinderman (right), award recipient

Student's Project Pays Off

Steven Karty, a 7th Grade Student at Brittany Junior High School, Is Shown Being Presented an A.S.M. Junior Achievement Award by A.S.M. Past National Trustee George A. Fisher, Jr. for His Project Dealing With the Design of a Modified Television Circuit Receiver

Speaker: John Trimble
Budd Co.

John Trimble, manager of carbonyl metal products, The Budd Co., presented "A Glimpse at Gas Plating" at the Honors Night meeting of the **Philadelphia Chapter.**

Highlights of the evening were the presentation of the Philadelphia Chapter's "Delaware Valley Metals Man of the Year" award and the presentation of 25-year membership certificates to several members.

Mr. Trimble stated that no plating is involved in the gas plating process since it is merely a method of depositing metal through the thermal decomposition of organometallic liquids. He explained a typical process using nickel carbonyl, and pointed out the hazards involved in working with this material and the complex problems presented in designing equipment to contain the material.

The gas plating process has many potential applications. It is good for intricate parts normally made by milling, machining and benchwork. Transmission and differential housings, rocker arms, etc., are some applications currently utilizing this process.

Walter Kinderman, well-known Chapter personality, received the "Delaware Valley Metals Man of the Year" award. The certificate he received contained the following citation:

"In recognition of your outstanding contribution to the engineering profession in promoting career guidance for students, your splendid record of achievement in promoting metallurgical education for men and women in the metals industry, your untiring and unselfish efforts on behalf of our Chapter and our Society, and for having the characteristics American Society for Metals members prefer and admire in their leaders".—**Reported by N. J. Petrella for Philadelphia.**

Luncheon Honored 25-Year, Student Members A.S.M.

Traditional closing day event for the Metal Show, the Distinguished Service Luncheon, was repeated on Friday, Nov. 6, at the Saddle and Sirloin Club in the Stockyards at Chicago.

Guests were veterans of 25-year or more members of A.S.M., as well as college students just embarking upon metals engineering careers.

The senior men of metalworking were seated across-table from the tyros to afford a lively exchange of ideas. Student guests were metallurgical majors at the Universities of Notre Dame, Purdue, Illinois Tech, Northwestern, Chicago and other campuses in the greater Chicago area.

A.S.M. officers discussed various phases of metalworking and teaching. The students toured the Metal Show in the adjacent Amphitheatre on the final afternoon.

Given Life Membership

Republic Steel Corp.'s president, Thomas F. Patton, was honored with a Distinguished Life Membership in the A.S.M. at the 4th Annual Awards Luncheon, Tuesday, Nov. 3, in Hotel Sherman. Mr. Patton was also the principal speaker at the luncheon.

He became president of Republic in 1956, and had been general counsel for the corporation and subsidiary companies beginning in 1944, and assistant president and first vice-president starting in 1953.

A graduate of Ohio State University, Mr. Patton's early career included service with a large law firm, where he gained first-hand knowledge of ore and coal mining by handling knotty legal problems for clients in those fields. During the 1930's he helped work out the complex merger of four companies which formed Republic Steel.

Steven Karty, 13 years of age and a 7th grade student at Brittany Junior High School, University City, Mo., was presented an American Society for Metals Junior Achievement Award. George A. Fisher, Jr., past national trustee and member of the St. Louis Chapter, briefly addressed the student body on the subject "What Is Metallurgy" and made the presentation during an assembly program at the school auditorium.

Steven Karty's project, which entitled him to receive this award, was the designing of a modified television circuit receiver. Steven's only interest at the present time, according to his instructor, Marshall Arky, is electronics. His time, after school hours, is spent repairing radios and television sets.

This young man participated in the Greater St. Louis Science Fair and won an award for designing an electronic vacuum tube. Another project for which he received a Science Fair Award was the designing of an electroscope, an instrument for detecting pressure of an electric charge on a body.

CHAPTER MEETING CALENDAR

Akron (Ohio)	**Dec. 16**	Sanginitis Restaurant		Toolsteels and Heat Treating
Baltimore	**Dec. 1**	Engineers Club		
Boston	**Dec. 4**	MIT Faculty Club	**Panel**	How Would You Heat Treat It?
Buffalo	**Dec. 10**	Continental Inn	**Allen Gray**	Space Age Demand on Materials
Calumet (Indiana)	**Dec. 8**	Phil Smidt Restaurant	**C. H. Elliott**	Industrial Psychology
Canton-Massillon (Ohio)	**Dec.**	Mergus Restaurant	**Karl T. Aust**	Structures and Properties of Grain Boundaries
Chicago	**Dec. 14**	Furniture Club	**Social**	Christmas Party
Chicago-Western	**Dec. 14**	Furniture Club	**Social**	Christmas Party
Cleveland	**Dec. 7**			National Officers Night
Columbia Basin (Washington)	**Dec.**		**Social**	Dinner Party
Dayton (Ohio)	**Dec. 9**	Engineers Club	**J. W. Spretnak**	Trends in Research
Eastern New York (Schenectady)	**Dec. 8**		**Social**	Christmas Party
Ft. Wayne	**Dec. 9**	Hobby Ranch House	**Social**	Ladies Night
Golden Gate (San Francisco)	**Dec. 7**		**Social**	Ladies Night
Hartford (Connecticut)	**Dec. 11**	Avon Country Club	**Social**	Christmas Party
Indianapolis	**Dec. 7**	Meridian Plaza Hotel	**Robert Kryter**	Sputniks Space and You
Jackson (Michigan)	**Dec. 4**	Arbor Hill Country Club	**Social**	Ladies Night
Kansas City	**Dec. 18**	Golden Ox Restaurant	**Social**	Christmas Party
Lehigh Valley (Pennsylvania)	**Dec. 14**	Carpenter Steel Co.	**Plant Visit**	
Louisville	**Dec. 1**		**C. K. Donoho**	Centrifugal Casting
Mahoning Valley (Ohio)	**Dec. 8**	Mural Bldg.	**C. Dale Dickenson**	Refractory Metals
Manitoba (Canada)	**Dec.**	Vasalund	**Social**	Christmas Party
Miami	**Dec. 14**	Woody's Steak House	**H. Horn**	Thermo-Electric Metals for Producing Heat and Cold
Milwaukee	**Dec. 8**	City Club	**Panel**	Factors in the Design of Castings
Minnesota	**Dec. 12**		**Social**	Christmas Party
Montreal	**Dec. 7**	Queen's Hotel	**F. G. Tatnall**	Philosophy of Measurement
Muncie (Indiana)	**Dec. 8**	Ball State Student Center	**H. R. Clauser**	Thinking and Problem Solving for Engineers
New Haven	**Dec. 4**		**Social**	Christmas Party
New Jersey	**Dec. 14**	Essex House	**Social**	Christmas Smoker
New York	**Dec. 7**	Brass Rail Restaurant	**Carl Samans**	Steels for Pressure Vessel Applications
North Texas (Ft. Worth)	**Dec. 11**	Elks Club	**Social**	Christmas Party
Oak Ridge	**Dec. 5**	Dean Hill Country Club	**Social**	Christmas Party
Ontario (Toronto)	**Dec. 4**	Prince George Hotel	**R. S. Davis**	Explosive Loading and Forming
Oregon (Vancouver-Portland)	**Dec. 15**	Riverside Country Club	**Social**	Christmas Party
Purdue	**Dec. 15**	Lafayette	**R. F. Mehl**	Crystal Growth
Philadelphia	**Dec. 10**	Four Chefs	**Social**	Christmas Party
Phoenix	**Dec. 29**		**T. U. Smith**	Books and the Business of Living
Rhode Island	**Dec. 2**	Johnson's Hummocks Grill	**F. D. Rosi**	Metallurgy of Semiconductors
Richmond (Virginia)	**Dec. 8**	Downtown Club	**R. Bennett**	Research and Development With Navy Slants
Rochester	**Dec. 14**	Manger-Seneca	**W. A. Pennington**	Mild Steel in Corrosion Service
Rockford (Illinois)	**Dec. 11**		**Social**	Christmas Party
St. Louis	**Dec. 12**	Statler-Hilton Hotel	**Social**	Christmas Dinner-Dance
Syracuse	**Dec. 1**	Onondaga Hotel	**W. W. Minkler**	Application of Titanium
Texas (Houston)	**Dec. 1**		**W. C. Schulte**	Fatigue Studies of High-Strength Steels
Tri-City (Moline-Davenport)	**Dec. 8**	Hotel Blackhawk	**Panel**	Machining
Tulsa	**Dec. 1**	Alvin Plaza Hotel	**R. A. Cooley**	Explosive Forming
Utah (Provo-Salt Lake)	**Dec. 12**	Newhouse Hotel	**Social**	Christmas Party
Washington (D. C.)	**Dec. 21**	All States Restaurant	**George Burton**	Electron-Beam Welding
West Michigan (Grand Rapids)	**Dec. 14**	Scottie's Restaurant	**Panel**	Revising Our Thoughts on the Selection of Materials
Worcester (Massachusetts)	**Dec. 9**	Cohasse Country Club	**W. Pennington**	Mild Steel and Corrosion Service
York (Pennsylvania)	**Dec. 9**	Lancaster	**F. D. Rosi**	Some Aspects of Metallurgy in Semiconductors

EMPLOYMENT SERVICE BUREAU

The Employment Service Bureau is operated as a service to members of the American Society for Metals and no charge is made for advertising insertions. The "Positions Wanted" column, however, is restricted to members in good standing of the A.S.M. Ads are limited to 50 words and only one insertion of any one ad. Address answers: c/o A.S.M., Metals Park, Novelty, Ohio, unless otherwise stated.

POSITIONS OPEN

East

PRODUCTION FOREMAN: Newly established tubing division of precision metals manufacturer requires production foreman with heavy practical experience in drawing copper capillary tubing on coilers or bull blocks. Salary $7500 to $9000, with advancement. Fringe benefits. Location, suburban New York City. Send resume in complete confidence. Box 11-15.

METALLURGIST: For research in powder metallurgy in expanding field of metal bonded diamond grinding wheels and related problems. Recent college graduate with or without advanced degree. Location: Worcester, Mass. Send resume to: W. H. Cheney, Supervisor of Recruiting, Norton Co., Worcester, Mass.

INSTRUCTOR — ASSISTANT PROFESSOR: Recent M.S. or Ph.D. in physical metallurgy to teach physical metallurgy and materials engineering courses to undergraduates. Research and consulting opportunities. Growing New England College. To start February or September 1960. Box 11-50.

METALLURGIST: Gillette has an immediate opening for a metallurgical engineer or mechanical engineer with metallurgical training. A minimum of two years in metallurgy, metallurgical engineering or comparable experience required. Thorough knowledge of ferrous metallography essential. METALLURGIST: To participate in and supervise development of strip hardening equipment. Excellent opportunity for aggressive engineer to advance in a vital, stable Boston concern. Salary commensurate with background and experience. Send resume to: James R. Schmitt, Gillette Safety Razor Co., Boston 6, Mass.

METALLURGIST: B.S. degree. Recent graduate with up to three years experience preferred. Duties would include supervision of applied research on projects related to nonferrous investment castings. Plant located in New England. Salary commensurate with qualifications. Box 11-55.

DESIGN ENGINEER: Familiar with heat treating furnaces, equipment and shop practice. Originality and versatility valued. Interesting, permanent opening with leading small business. State qualifications fully. Box 11-60.

Midwest

PLANT METALLURGIST: With minimum of ten years experience in wire mill operations and cold heading and heat treating of fabricated wire products, to manage quality control laboratory and direct heat treating and related technical operations, in new integrated processing plant and wire mill. Send resume and salary requirements. Box 11-20.

RESEARCH METALLURGIST: M.S. degree or B.S. with exceptionally strong research experience in physical metallurgy. Knowledge of X-ray diffraction desirable. Research programs involve determination of rolling textures, phase diagrams, recrystallization studies, high-temperature protective coatings and alloy development. Opportunity for collegiate teaching. Salary competitive with industry. Send resume to: Special Projects Division, University of Dayton Research Institute, Dayton 9, Ohio.

METALLOGRAPHER: With three to five years experience in all phases of metallography for employment in modern laboratory dealing with many unique metallographic problems. Background in X-ray diffraction desirable. Salary competitive with industry. Send complete resume to: Special Projects Division, University of Dayton Research Institute, Dayton 9, Ohio.

METALLURGIST: B.S. or M.S. degree, 25 to 32 years old, with several years experience in metallography, ferrous metals and alloys and report writing. Position in Pittsburgh district offers excellent advancement opportunities, interesting development work, permanence, and liberal salary, depending on experience and ability. Box 11-25.

METALLURGISTS AND METALLURGICAL ENGINEERS: Challenging opportunities exist for the career scientist or engineer with this primary refiner and diverse fabricator of refractory metal products. Our rapid expansion assures you of an assignment to match your training and ability in the areas of basic and applied research and development, design and process work and manufacturing. Send resume in confidence to: Professional Personnel Officer, Fansteel Metallurgical Corp., 2200 Sheridan Rd., North Chicago, Ill.

METALLURGICAL ENGINEER: Opportunity to grow with a progressive special metals producer. Two to three years mill-process engineering experience desirable. Duties include establishment, improvement and control of metalworking operations which include hot and cold rolling, forging, drawing, extrusion and writing specifications. Knowledge of titanium and zirconium desirable but not a requisite. Send resume and salary requirements in confidence to: Mallory-Sharon Metals Corp., Box 281, Warren Ave., Ext., Niles, Ohio.

METALLURGIST: B.S. or M.S. degree; Chicago district; age limits 25 to 32 years. Experience in metallography, steel and iron alloys and report writing preferred. Permanent position leading to advancement along production, sales or research lines. Present work in interesting development functions, liberal

GAS • OIL • ELECTRIC
DIRECT FIRED OR ATMOSPHERE CONTROLLED

Production Heat Treating Equipment

Of any of these types

• BATCH • CONVEYOR • ROTARY
• CAR TYPE • SHAKER HEARTH
• ROLLER TYPE • WALKING BEAM

HOLCROFT & COMPANY

6545 EPWORTH BLVD. DETROIT 10, MICHIGAN
43 YEARS OF ENGINEERING LEADERSHIP

salary depending on experience and ability. Box 11-65.

METALLURGICAL ENGINEER: Graduate. Experience in low-alloy and austenitic high-temperature alloys preferred, but will consider recent graduate. Assignment in process control laboratory of major automotive parts manufacturer. Work covers forging, cold forming, heat treating methods. $6500/9600 per year. Cleveland. Box 11-70.

METALLURGIST — STAINLESS STEEL PRODUCER: Metallurgist for technical contact with customers for stainless bar, wire and forging billets. Well versed in mill production, inspection, lab practice and uses of these products. Customer contact experience desirable. Send resume of experience, education and salary requirements to: Employment Office, Universal-Cyclops Steel Corp., Drawer 153, Bridgeville, Pa.

West

DEVELOPMENT METALLURGICAL ENGINEER: Expanding investment casting company needs man with technical background to work on development programs in engineering department. Gating experience essential. Degree in metallurgy or equivalent foundry experience preferred. New plant, profit sharing plan and excellent working conditions. Send complete resume of work history, education and salary expected to: Precision Castparts Corp., 4600 S.E. Harney Dr., Portland, Ore.

POSITIONS WANTED

PROCESS METALLURGIST: B.S. degree, 35 years old, looking for position where common sense counts and suburban living, grass, trees and space for a family is available, in exchange for hard work backed up by ten years experience including supervision of a metallurgical laboratory, metallography, trouble shooting, development work, heat treating, liaison with manufacturing, design engineers, customers and suppliers. Resume on request. Box 11-30.

METALLURGIST: Melting metallurgist and supervisor in laboratory of production ferrous foundry since receipt of B.S. degree in December 958. Desires more challenging position in metallurgical development. Undergraduate experience includes physical testing and failure analysis of wide variety of ferrous and nonferrous metals, and applied research in welding nonferrous shipbuilding materials. Box 11-35.

ENGINEER-ADMINISTRATOR: B.S., M.S., Met.E., Master business administration. Research and development experience with high-temperature materials, light metals, etc., currently training director and management development for large research and development operation. Age 28, family, veteran. Desires industrial management, engineering administration or technical sales. Available January 1960. Box 11-40.

GRADUATE METALLURGIST: Age 35. Ten years experience in organization and administration of metallurgical production and development laboratories. Presently manager of quality. Desires metallurgical challenge in material development and processing. Knowledge of metals and metal processing in aircraft high-temperature and titanium forging, automotive foundry. Prefers West Coast or Denver. Box 11-45.

SENIOR METALLURGISTS

One metallurgist to conduct research in field of vacuum metallurgy and alloy development; another to investigate properties of metals under unusual conditions of temperature, loading, time and stress concentration, and to determine fundamental nature of deformation and fracture under these conditions. Aptitude for research and ability to write reports essential. Excellent working conditions and opportunity for professional growth.

SOUTHERN RESEARCH INSTITUTE
BIRMINGHAM 5, ALABAMA

Research Scientists

FOR BASIC & APPLIED RESEARCH AT

Sylvania's Research Laboratories

Significant expansion of company-supported research in solid state physics, physical electronics, metallurgy and physical chemistry has created a number of exceptional opportunities at several levels, up to Senior Scientist or Section Head. Inquiries are invited from persons with appropriate training and experience who would be interested in participating in one of the following programs:

REFRACTORY METALLURGY

Theoretical and experimental investigations of all phases of the metallurgy of refractory metals and alloys including process, fabrication, physical and mechanical metallurgy.

ELECTRONIC MATERIALS

Synthesis and evaluation of materials and studies of the basic mechanisms involved in magnetics, ferrites, phosphors and dielectrics.

ELECTRONIC COMPONENTS

Investigations of techniques and materials involved in microminiaturization and integrated circuits.

ANALYTICAL CHEMISTRY

Analysis of ultra-trace impurities in electronic materials, semiconductors and metals including the development of new analytical techniques.

THERMIONIC EMISSION

Studies of the basic mechanisms of electron emission from high and low temperature surfaces; experimental evaluation of emission properties of base alloys, films and matrix forms.

MICROWAVE & ULTRA-MICROWAVE ELECTRONICS

Theoretical and experimental investigations of Maser-like devices and parametric amplifiers, including microwave spectroscopy studies of paramagnetic crystals.

SEMICONDUCTOR DEVICES

Theoretical and experimental studies of new devices and device concepts, new fabrication techniques and the applications of new semiconductor materials and phenomena.

SEMICONDUCTOR MATERIALS & POLAR CRYSTALS

Studies of the basic phenomena and properties of existing and new materials with these characteristics.

Modern, fully equipped laboratories, considerable scientific freedom, and association with staff members of established scientific prestige afford realistic opportunities for professional growth and recognition.

Please submit resume in confidence to Mr. A. E. Powell, Dept. 11-M

RESEARCH LABORATORIES

SYLVANIA GENERAL SYSTEM

Subsidiary of

GENERAL TELEPHONE & ELECTRONICS

Bayside, Long Island, New York

METALLURGISTS

Thiokol's fast-rising Utah Division has several openings available, including supervisory positions, in connection with metals research and development programs in solid-propellant rocketry.

Opportunities exist in physical and mechanical metallurgy; development and processing of high-strength steels, refractory metals and high-temperature alloys; X-ray diffraction, spectroscopy and analytical chemistry.

Please send complete resume, including current earnings and salary requirement to Mr. Stephen L. Robinson.

Thiokol
CHEMICAL CORPORATION
UTAH DIVISION
Personnel Offices: 120 South Main St., Brigham City, Utah

METALLURGISTS

Excellent opportunity to grow with a progressive expanding company for graduates with B.S. degree and up to five years experience, to carry out work in laboratory programs on extraction, alloying, melting, extrusion, welding, rolling.

Salary commensurate with qualifications and experience.

Send resumes in confidence or call collect—

Richard M. Quimby,
Personnel Director
The Beryllium Corp.
P. O. Box 1462
Reading, Pa.

PHYSICAL METALLURGIST Excellent Future With CRUCIBLE STEEL COMPANY OF AMERICA

Outstanding opportunities for advancement exist in this specialty steel company with its alert, aggressive management. Current opening for physical metallurgist to do advanced work in the physical metallurgy of toolsteels with specific emphasis on high speed toolsteels. Prefer Ph.D. and 3 to 5 years' experience in ferrous physical metallurgy, not necessarily toolsteel.

Excellent employee benefit programs. Ability and experience will receive recognition in salary consideration.

Send resume and salary requirement to

Mr. J. E. Harris
CRUCIBLE STEEL CO.
OF AMERICA
P. O. Box 88
Pittsburgh 30, Pa.

METALLURGICAL ENGINEER: Ten years diversified experience in precious metals including industrial sales, customer liaison and alloy development. Strong background in process metallurgy involving casting, rolling, extrusion, wire drawing. Seeks position in administration, product sales or technical service. Box 11-75.

METALLURGICAL CHEMIST: Presently directing a research program involving metal treatment and finishing; electroplating, hot dipping, cladding, phosphating, diffusion and conversion coatings, lacquering, anodizing, corrosion testing. Physical metallurgy background in ferrous and nonferrous metals. Desires similar position, or as chief chemist or metallurgist in production control and testing, with firm in this field. Box 11-80.

METALLURGICAL ENGINEER: Met.E. and M.B.A. degrees, age 29, married, family. Desires position in technical marketing or field engineering in a metallurgical industry. Four years research experience in refractory metals, tool materials, powder metallurgy. Supervisory experience. Box 11-85.

LIGHT METAL EXTRUSION ENGINEER: With over 17 years experience in all phases of plant operation including melting, casting, extrusion and fabrication. Background includes sales, engineering, metallurgy and management. Interested in technical sales of basic materials or equipment, or plant management in the light metals extrusion field. Box 11-90.

SALES-PROJECT ENGINEER: Or administrative assistant. Metallurgical degree. Twenty years of diversified experience in openhearth, inspection, appliance manufacturing and sales. Will relocate, travel. Box 11-95.

TOOLSTEEL AND HIGH-TEMPERATURE ALLOY SALESMAN: Progressive company looking for salesman with experience for the Houston and Dallas territory. Excellent chance for advancement.

Box 11-5, Metals Review

LITERATURE METALLURGIST or LIBRARIAN

The American Society for Metals needs a top-notch person to conduct bibliographic searches, operate library. Must have good technical knowledge of metallurgical field and acquaintance with library indexing tools and techniques. Splendid opportunity to get in on the ground floor of A.S.M.'s new Metals Documentation Service. Library is expected to grow rapidly both in holdings and services. Send full particulars of training and experience to:

American Society for Metals
Att: Mrs. Marjorie R. Hyslop
Metals Park
Novelty, Ohio

J&L STEEL

RESEARCH METALLURGISTS

Continuing growth of the J&L research and development program has created a number of openings for professional personnel, holding Ph.D., M.S., or B.S. degrees in metallurgy or a related scientific field. Projects underway or in prospect cover a diversity of subjects in physical and process metallurgy, all of course, related to the production of carbon and stainless steels, and all company supported. Because of this diversity, it is almost always possible to accommodate individual interests.

The J&L Research Division is housed in the modern, air-conditioned, fully-equipped Graham Laboratory in suburban Pittsburgh. Attractive residential areas are close by. And progressive Pittsburgh offers many advantages, including full graduate programs at the University of Pittsburgh and Carnegie Institute of Technology for the man who wants to continue his professional education.

If you have these interests, we would like to hear from you, and will respect your confidence. Write.

J. A. Hill
Research and Development Department
JONES & LAUGHLIN STEEL CORPORATION
#3 Gateway Center
Pittsburgh 30, Pennsylvania

P.S. Graduating in 1960? Let us know early, so we can arrange to talk with you during the winter.

DU PONT
REG. U. S. PAT. OFF.

OPPORTUNITIES IN PRODUCTION METALLURGY
E. I. DU PONT DE NEMOURS & COMPANY

New opportunities in the growing and important field of refractory metals are now available with du Pont at a new facility to be located in Baltimore, Maryland. A major expansion in alloy development, metal manufacture and mill product processing techniques is being conducted. Two supervisory positions are open for men who have from 5 to 10 years' experience in metals processing.

Production Supervisor—Rolled Products

The position requires the daily supervision of the rolling and finishing areas. The rolling area consists of multi-purpose rolling facilities, unique in design, and capable of very diversified operations. Both hot and cold rolling of sheet, bars and coils of refractory metals will be involved. Experience in finishing, heat-treating and inspection is essential.

Production Supervisor—Melting

The position requires previous experience in consumable electrode-cold mold-arc melting operations. In addition, thorough knowledge of electrode preparation and the behavior of refractory metals on melting and solidification is required.

Trained personnel in physical and mechanical metallurgy or those with equivalent experience are needed for these supervisory openings. Please forward resume, including details of education, experience and salary expected to Mr. A. F. Hartford, Employee Relations Department, E. I. du Pont de Nemours & Company, Wilmington, Delaware. Replies held confidential.

Metallurgists

Career opportunities in Research & Development with rapidly expanding company.

The Bridgeport Brass Company provides exceptional career openings for qualified metallurgists with the ability to participate in—and lead—activities in the non-ferrous and special metals field. These openings offer outstanding opportunities in a dynamically growing 12-plant company. Complete and modern benefits program is provided.

Challenging positions for:

MECHANICAL METALLURGIST (Bridgeport, Conn.)

Advanced degree (Metallurgy or Mechanical Engineering) or equivalent experience in fundamental problems of metal deformation. Lead development of new metal working processes, emphasis on Space Age metals.

ASSOCIATE RESEARCH METALLURGIST (Bridgeport, Conn.)

Strong background in physical metallurgy. Experience in aluminum alloys desirable. Plan and conduct research involving the constitution and structure of non-ferrous alloys.

ASSISTANT RESEARCH METALLURGIST (Bridgeport, Conn.)

Metallurgical degree. About 2 yrs. experience in research or related work. Interest in physical metallurgy and alloy development. Conduct research involving development and testing of copper and aluminum-base alloys.

BRASS Bridgeport CO

Please send complete resume, letter of application, salary requirements and availability date to: Mr. F. J. Finsinger, Personnel Manager

BRIDGEPORT BRASS CO.
30 Grand Street, Bridgeport 2, Conn.

ENGINEERING SUPERVISOR

For Magnetics Group engaged in imaginative development of new melting processing techniques. Salary open. Should have minimum 5 years experience in magnetic alloy development and at least BS degree.

SUPERVISOR OF PILOT PLANT

Development of structural alloys to include high temperature alloys, room temperature and high rotor materials, non-magnetic high strength alloys, nuclear structural materials, etc.

SUPERVISOR OF PILOT PLANT

Development of metallurgical processing techniques such as vacuum arc and vacuum induction melting, ultrasonic vibrations, extrusion, various methods of rolling and drawing, heat treating, etc.

You will be associated with one of the largest industrial corporations in the U. S. and will be afforded unlimited opportunity to display your ability.

Salaries open. Send confidential resumes to:

BOX 11-10, Metals Review

METALLURGIST

Marked expansion in beryllium copper research offers unusual opportunities for senior men. Ph.D.'s preferred but B. S.'s with substantial research experience equally acceptable. Positions of Manager and Supervisor open.

Excellent opportunity to grow with the leading producer of beryllium products.

Send resumes in confidence or call collect—

Richard M. Quimby,
Personnel Director
The Beryllium Corp.
P. O. Box 1462
Reading, Pa.

METALLURGISTS

for career opportunities in

RESEARCH and DEVELOPMENT

•

Battelle has openings for qualified metallurgists in the areas of:

- PHYSICAL METALLURGY
- ALLOY DEVELOPMENT
- MECHANICAL WORKING OF METALS
- PROCESS DEVELOPMENT

We offer competitive salaries, opportunity for professional growth and recognition, and many unique advantages. Write to Mr. L. G. Hill,

Battelle Memorial Institute
505 King Avenue
Columbus 1, Ohio

Metallurgists

For work on
Materials Research
Liquid Metal Technology
Metallography and Effects of Radiation on Materials

•

Interesting Opportunities
in the field of Liquid Metal Fuel Reactor Systems
exist at a laboratory engaged in
FUNDAMENTAL & APPLIED RESEARCH ON NUCLEAR REACTOR COMPONENTS

•

Candidates should have an advanced degree or experience

SEND COMPLETE RESUME
to
Employment Supervisor

BROOKHAVEN
NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.
UPTON, L. I., N. Y.

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (TITLE 39, UNITED STATES CODE, SECTION 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF

METALS REVIEW
PUBLISHED MONTHLY AT CLEVELAND, OHIO
FOR OCTOBER 1, 1959

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, American Society for Metals, Metals Park, Novelty, Ohio; Editor, Betty A. Bryan, Metals Park, Novelty, Ohio; Managing Editor, None; Business Manager, None.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.) The American Society for Metals, Metals Park, Novelty, Ohio, which is an educational institution, the officers being: President, C. H. Lorig; Vice-President, Walter Crafts; Treasurer, R. H. Aborn; Secretary, W. E. Jominy; Trustees, G. M. Young, John H. Hollomon, E. E. Stansbury, Earl Parker and M. A. Schell. All officers as above, Metals Park, Novelty, Ohio.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only.)

Betty A. Bryan, Editor

Sworn to and subscribed before me this 15th day of Oct., 1959. (Seal) Laura M. Tracy, Notary Public. (My commission expires Nov. 6, 1960)

NOW BASIC METALLURGY II

NEW COMPANION VOLUME TO FAMED BASIC METALLURGY I

This easy-to-read and practical book describes the equipment and its use for metallurgical operations. This is a practical guide to metallurgical equipment, test and techniques.

Well-illustrated with 67 pictures, 17 pull-out data sheets and 37 charts and graphs, Basic Metallurgy II contains a comprehensive 8-page index for handy use plus 68 references to other authoritative sources.

Table of Contents

PURPOSE AND KINDS OF TESTING
TENSION TESTING MACHINES
HARDNESS TESTING
OTHER MECHANICAL TESTS
NONDESTRUCTIVE TESTING
MACROSCOPIC TESTING
MICROSCOPIC INVESTIGATION
PYROMETRY
HEAT TREATING EQUIPMENT
PREPARED ATMOSPHERES FOR HEAT TREATMENT
CORROSION TESTING
MISCELLANEOUS TESTING

$7.50 . . . 232 Pgs. PLUS 17 Data Sheets . . . Red Cloth Binding

ASM Technical and Engineering Book Information Service
METALS PARK, Novelty, Ohio—Dept. 11-R

Enclosed please find $........................ for copy(s) of Basic Metallurgy, Volume II.

Or: Bill me ☐ Bill Company ☐

Name ....

Street & No. ....

City .... Zone .... State ....

Company ....

Metallurgists to develop

ALLOYS FOR REACTOR APPLICATIONS

The Bettis Atomic Power Laboratory offers the metallurgist a wide range of experimental and applied reactor metallurgy problems, which include the development of new fuel materials—alloys, ceramics and dispersions for extending reactor life at higher temperatures; radiation studies; development of new types of cladding, and applying existing materials to nuclear systems.

If you are a metallurgist and are interested in pursuing a career in reactor and nuclear power system metallurgy and are a U.S. Citizen, write to: Mr. M. J. Downey, Dept. B-7, Bettis Atomic Power Laboratory, Westinghouse Electric Corporation, P. O. Box 1526, Pittsburgh 30, Pennsylvania.

Zr

Diffusion Interface

Hf-Zr

Hf

Joining of Hf to Zr by welding

BETTIS ATOMIC POWER LABORATORY

Westinghouse

BETTER YOUR FUTURE AT BETTIS

A Study in Applied Creativity at KAPL — directed to Engineers & Scientists to whom an environment of academic freedom is of first importance...

† Longitudinal section of 200-μ UO_2 dispersed in Zircaloy matrix. 30X. BF. Reduced approximately 38% for reproduction.

Transverse section of 200-μ UO_2 dispersed in Zircaloy matrix. 30X. BF. Reduced approximately 38% for reproduction.

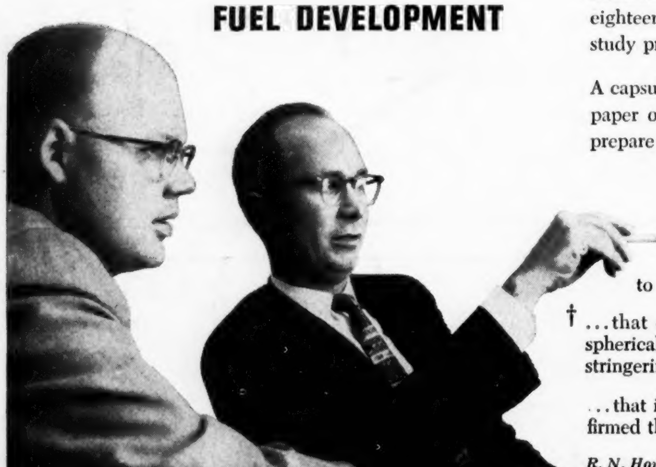
NARROWING THE "DEPARTURE FROM IDEALITY" IN DISPERSION FUEL DEVELOPMENT

Scientists have long been cognizant ot the theoretical advantages of applying the dispersion theory to reactor fuel elements. Ideally this concept could be utilized to extend substantially fuel rod life in high performance water cooled reactors.

But it remained for KAPL Metallurgists Dr. A. P. Beard and R. N. Honeyman to solve basic problems of process metallurgy involved and achieve *actual fabrication* of zirconium-alloy base dispersion elements which were a significant step closer to the theoretical ideal.

Encouraged by Dr. C. E. Weber, Manager of Basic Materials Development, and a leading figure in Dispersion Element research — and aided by consultation with specialists in several KAPL laboratories — Beard and Honeyman successfully completed evaluation of the irradiation behavior of their first samples in September 1958, only eighteen months (and 2 volumes of experimental data) after the study program was formally initiated.

A capsule description of their findings appears below. Reprints of a paper outlining the experimental method and techniques used to prepare laboratory samples will be furnished on request.



Summary of Findings: Dispersion Fuel Study

...showed that mechanical attritioning could be used to prepare zirconium powder with high corrosion resistance.

† ...that extrusion of dispersions of 200 micron dia. particles of spherical UO_2 & UC could be achieved at 750° C with little or no stringering and no reaction between particles and Zircaloy matrices.

...that irradiation behavior of zirconium base dispersion fuels confirmed theoretical concepts of such systems.

R. N. Honeyman (l.) and A. P. Beard (r.)

Engineers and scientists who appreciate an environment where free inquiry and creative initiative are encouraged are invited to investigate these immediate openings: Advanced numerical analysis (PhD) * Computer operations * Computer programming * Mathematical statistics (PhD) * Analytical chemistry, X-ray diffraction * Chemical analysis, vacuum techniques * Radiochemistry * Ceramic materials development (PhD) * Physical metallurgy * Powerplant systems analysis * Powerplant & reactor instrumentation * Reactor physics * Reactor mechanical design * Heat transfer, fluid flow * Mass spectrometry * Stress analysis * Reactor plant operation

Send your resume in confidence, including salary requirement. We are interested in your technical achievements and interests.

(U.S. citizenship required)

Address: MR. A. J. SCIPIONE, DEPT. 43-MK

Knolls Atomic Power Laboratory

OPERATED FOR A E C BY

GENERAL ELECTRIC

SCHENECTADY, N. Y.